20-242-13

TM 5-4520-242-13

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, AND DIRECT SUPPORT MAINTENANCE MANUAL

HEATER, SPACE MULTIFUEL WITH BLOWER, 15,000 BTU/HR, 28 VDC (VBM MODEL VBM 15-IV) NSN 4520-01-032-7363

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

21 SEPTEMBER 1979

TM 5-4520-242-13
C1

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 5 February 1985

Operator's, Organizational, and Direct Support Maintenance Manual

HEATER, SPACE MULTIFUEL WITH BLOWER, 15,000 BTU/HR, 28 VDC (VBM MODEL VBM 15-IV) NSN 4520-01-032-7363

TM 5-4520-242-13, 21 September 1979, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-5 and 2-6	2-5 and 2-6
4-13 through 4-16	4-13

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25C, Operator, Organizational, and Direct and General Support Maintenance Requirements for Heaters, Space, 15,000 BTU.

WARNING

SHOCK HAZARD

The ignition system of this heater contains dangerous voltages which can cause severe electrical shock. Be extremely careful when making voltage measurements or other checks with the heater connected to the power source during troubleshooting. Always disconnect the power plug before making any continuity tests or before repairing the heater.

POISONOUS GAS HAZARD

Do not operate this heater in an enclosed area unless exhaust gases are piped to the outside. Do not locate the heater where expelled exhaust gases can be recirculated into inlet air openings of the heated space. The exhaust gases may contain carbon monoxide, a colorless, odorless, deadly poisonous gas. Inhalation of exhaust fumes can cause serious illness or death. Stop heater operation and check exhaust connections if exhaust gas odors are apparent in the enclosure.

HEALTH HAZARD

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

DEATH

or serious illness may result from inhalation of exhaust fumes. The heat exchanger confines the combustion gases and directs them to the exhaust pipe. It must be air tight to prevent harmful combustion products from entering the heated enclosure. Any crack or hole through the exchanger walls requires exchanger replacement.

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(VBM MODEL VBM 15-IV)
NSN 4520-01-032-7363

REPORTING OF ERRORS

You can help improve this manual by calling attention to errors and by recommending improvements, using DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 (Test), located in back of manual, or by a letter, and mail directly to Commander, U.S. Army Troop Support Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished directly to you.

			Paragraphs	Pages
CHAPTER	1.	INTRODUCTION		
Section	I.	General	1-1	1-1
	II.	Description and data	1-8	1-3
CHAPTER	2.	OPERATING INSTRUCTIONS		
Section	I.	Description and use of operator's controls and indicators	2-1	2-1
	II.	Preventive maintenance checks and services	2-3	2-5
	III.	Operation under usual conditions	2-5	2-7
	IV.	Operation under unusual conditions	2-9	2-8
CHAPTER	3.	OPERATOR/CREW MAINTENANCE INSTRUCTIONS		
Section	I.	Lubrication instructions	(Not Applicable)	
	II.	Troubleshooting procedures	3-1	3-1
CHAPTER	4.	ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section	I.	Service upon receipt of materiel	4-1	4-1
	II.	Movement to new worksite	4-4	4-10
	III.	Repair parts, special tools, and equipment	4-6	4-11
	IV.	Lubrication instructions	(Not Applicable)	
	V.	Preventive maintenance checks and services	4-8	4-11
	VI.	Troubleshooting	4-9	4-17
	VII.	Radio interference suppression	4-11	4-27
	VIII.	Maintenance of heater case	4-16	4-27
	IX.	Maintenance of electrical components	4-19	4-33
	X.	Maintenance of burner assembly	4-23	4-38
	XI.	Maintenance of fuel system	4-25	4-42

			Paragraphs	Pages
CHAPTER	5.	DIRECT SUPPORT MAINTENANCE INSTRUCTIONS		
Section	I.	Repair parts, special tools, and equipment	5-1	5-1
	II.	Troubleshooting	5-4	5-1
	III.	General maintenance	5-6	5-16
	IV.	Removal and installation of major components and assemblies	5-10	5-17
CHAPTER	6.	REPAIR OF CONTROL PANEL	6-1	6-1
CHAPTER	7.	REPAIR OF IGNITION POWER SUPPLY	7-1	7-1
CHAPTER	8.	REPAIR OF ELECTRICAL CONTROL COMPONENTS . .	8-1	8-1
CHAPTER	9.	REPAIR OF BURNER	9-1	9-1
CHAPTER	10.	REPAIR OF FUEL SYSTEM	10-1	10-1
CHAPTER	11.	REPAIR OF HEAT EXCHANGER, EXHAUST CONNECTION, AND RAIN SHIELD	11-1	11-1
CHAPTER	12.	REPAIR OF BLOWER ASSEMBLY	12-1	12-1
CHAPTER	13.	REPAIR OF AIR COMPRESSOR	13-1	13-1
APPENDIX	A	REFERENCES	A-1	A-1
APPENDIX	B	COMPONENTS OF END ITEMS LIST	B-1	B-1
APPENDIX	C	EXPENDABLE SUPPLIES AND MATERIALS LIST	C-1	C-1
APPENDIX	D	MAINTENANCE ALLOCATION CHART	D-1	D-1
INDEX		. . . .		Index 1

LIST OF ILLUSTRATIONS

Number	Title	Page
1-1	Multifuel space heater, left front, three-quarter view	1-5
1-2	Multifuel space heater, right rear, three-quarter view	1-6
1-3	Electrical schematic diagram	1-7
1-4	Electrical wiring diagram	1-8
2-1	Heater controls and connectors	2-3
2-2	Room thermostat	2-4
2-3	Instruction plate	2-9
4-1	Typical exhaust connection	4-2
4-2	Base plan	4-4
4-3	Multifuel space heater, right rear, three-quarter view	4-5
4-4	Room thermostat	4-7
4-5	Heater controls and connectors	4-8
4-6	Fuel adjustment	4-9
4-7	Fuel filter	4-20
4-8	Side view of heater showing internal components	4-21
4-9	Fuel adjustment	4-22
4-10	Exhaust installation	4-24
4-11	Combustion air tube installation	4-26
4-12	Heater case assembly, exploded view	4-29
4-13	Control panel, exploded view	4-32

Number	Title	Page
4-14	Electrical system operation	4-34
4-15	Burner assembly, exploded view	4-40
4-16	Fuel flow diagram	4-43
4-17	Side view of heater showing internal components	4-44
4-18	Top view of heater showing internal components	4-45
4-19	Fuel filter, exploded view	4-47
4-20	Fuel system, exploded view	4-49
4-21	Fuel pump filter, exploded view	4-52
5-1	Timer components, exploded view	5-3
5-2	Control relay terminal identification	5-5
5-3	Ignition power supply, exploded view	5-8
5-4	Blower motor support, exploded view	5-11
5-6	Blower and motor, exploded view	5-13
6-1	Electrical schematic diagram	6-2
6-2	Electrical wiring diagram	6-3
6-3	Control panel components, exploded view	6-4
6-4	Timer components, exploded view	6-6
7-1	Ignition power supply, exploded view	7-2
7-2	Ignition case top, interior view	7-6
8-1	Control relay, terminal blocks, and resistor, exploded view	8-2
8-2	Thermostats, delay relay, and fuel heater, exploded view	8-3
8-3	Control relay terminal identification	8-6
9-1	Burner, exploded view	9-2
10-1	Fuel float bowl, solenoid valve, and fuel preheater, exploded view	10-3
10-2	Fuel pump, exploded view	10-6
11-1	Heat exchanger, exhaust connection, and rain shield, exploded view	11-2
12-1	Blower motor support, exploded view	12-2
12-2	Blower and motor, exploded view	12-3
12-3	Blower motor, exploded view	12-4
12-4	Blower housing, exploded view	12-7
13-1	Compressor assembly, exploded view	13-2
13-2	Air compressor, exploded view	13-4

LIST OF TABLES

Number	Title	Page
1-1	Tabulated Data	1-9
2-1	Controls and Indicators	2-2
2-2	Operator/Crew Preventive Maintenance Checks	2-6
3-1	Operator/Crew Troubleshooting	3-2
4-1	Organizational Preventive Maintenance Checks and Services, Quarterly Schedule	4-13
4-2	Organizational Maintenance Troubleshooting	4-18
5-1	Direct Support Troubleshooting	5-2

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. SCOPE. This manual is for your use in operating and maintaining the Heater, Space, Multifuel, with Blower, 15,000 Btu/hr (3780 kg-c), 28 vdc Model VBM 15-IV.

1-2. MAINTENANCE FORMS AND RECORDS.

a. Maintenance forms and records that you are required to use are as follows:

(1) DA Form 2402 (Exchange Tag).

(2) DA Form 2404 (Equipment Inspection and Worksheet).

(3) DA Form 2407 (Maintenance Request Used for Requesting Support Maintenance).

(4) DA Form 2407-1 (Continuation Sheet Used for Requesting Support Maintenance).

b. For additional forms and records pertaining to your particular equipment, refer to TM 38-750 (The Army Maintenance Manual System [TAMMS]).

1-3. ADMINISTRATIVE STORAGE.

a. General.

(1) Equipment that is placed in administrative storage should be capable of being readied to perform its mission within a 24-hour period or otherwise may be prescribed by the approving authority.

(2) Report equipment in administrative storage in Materiel Readiness and Unit Readiness reports as prescribed for all reportable equipment.

(3) Perform inspections, maintenance services, and lubrications in accordance with the instructions in this manual.

b. Storage Site.

(1) Select the best available site for storage. Separate stored equipment from equipment in use. Conspicuously mark the area "Administrative Storage".

(2) Covered space is preferred. Open sites should be improved hardstand, if available. Unimproved sites should be firm, well-drained, and kept free of excessive vegetation.

c. Storage Plan.

(1) Store equipment so as to provide maximum protection from the elements and to provide access for inspection, maintenance, and exercising.

(2) Take into account environmental conditions, such as extreme heat or cold; high humidity; blowing sand, dust, or loose debris; soft ground; and take adequate precautions.

d. Maintenance Services and Inspection.

(1) Prior to storage, perform the next scheduled major preventive maintenance checks and services. Inspect and approve equipment.

(2) Correct all shortcomings and deficiencies. Clean the equipment of dirt, grease, and other contaminants.

(3) Remove rust and damged paint by scraping, wire brushing, sanding, or buffing. Sand to a smooth finish and spot paint, as necessary.

(4) After cleaning and drying, immediately coat unpainted surfaces with an oil or grease as appropriate.

(5) Install all covers; close and secure all openings except those required for venting and draining. Seal openings to prevent entry of rain, snow, or dust. Place equipment and provide adequate blocking to allow for draining of water.

1-4. EQUIPMENT SERVICEABILITY CRITERIA. This equipment is not covered by an ESC.

1-5. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

a. Destruction by Misuse.

(1) Pour sand and gravel into the fuel supply.

(2) Block air inlet and outlet passages with oil-soaked rags or debris.

b. Mechanical Destruction. Using an axe, pick, mattock, sledge, or any other heavy implement, damage all vital elements such as controls, fuel pump, switches and valves, motor and any other major assemblies and components.

c. Destruction by Fire. Pour fuel over unit and pile quantities of flammable material around unit. Burn assemblies and components on a priority basis if possible. Proper concentration of equipment to be burned will produce a hotter, more destructive fire. Fires should be lit after mechanical destruction has been accomplished.

d. Destruction by Gunfire.

WARNING

Point blank firing at equipment should not be attempted unless the safety of all personnel in the area is assured.

Fire on the equipment with the heaviest weapons available, aiming at the major assemblies and controls.

e. Use of Natural Surroundings.

(1) Submergence of equipment and repair parts underwater (lakes, ponds, bogs, swamps, etc.), or by concealment by hiding material in caves or preferably by burial, can be used effectively.

(2) Widely dispersed scattering of material, preferably into heavy underbrush, can serve as a denial or delaying measure. In the event the area is recaptured, effort should be made to recoup concealed items.

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS.

EIR's will be prepared on SF Form 368, Equipment Defeciency Report. Instructions for preparing EIR's are provided in TM 38-750, THE ARMY MAINTENANCE MANAGEMENT SYSTEM (TAMMS). EIR's should be mailed directly to Commander, U.S. Army Troop Support and Aviation Materiel Readiness Command, St. Louis, Missouri 63120. A reply will be furnished to you.

Section II. DESCRIPTION AND DATA

1-7. DESCRIPTION.

NOTE

Dimensions and tolerances are given in U.S. Standard and metric units. Metric units are enclosed in parentheses.

a. The Model VBM 15-IV Multifuel Space Heater is designed for heating enclosures at which a source of 28-volt direct current power source is available. It has a maximum output of 15,000 Btu (3780 kg-c) per hour, and is designed for floor or wall installation. The heater is controlled by a remotely mounted thermostat to maintain a selected temperature in an enclosed space within the range of 35° to 95°F (1.7° to 35°C) up to the rated output of the heater.

b. The heater will operate satisfactorily on any gasoline conforming to Specification MIL-G-3056, VV-G-76, or any other gasoline (leaded or aromatic) of up to 100-octane grade. It will also burn diesel fuel which conforms to Specification VV-F-800, Class DF-1, DF-2, or DF-A, having a cloud point of not less than -55°F (-48°C). Air craft turbine fuels JP-4 and JP-5, conforming to Specification MIL-T-5624, will also operate this heater.

c. The heater is equipped with a removable discharge louver (fig. 1-1) for directing the outlet air. A screened air inlet opening provides for entry of circulating air. Combustion air is provided by a separate impeller assembly and enters the heater through an opening at the rear of the heater.

d. The heater is equipped with a timed ignition control for safe starting without continuous operator supervision. A safety control will shut off the power if ignition does not occur within 5 seconds, minimizing risk of fire or explosion and protecting the unit from damage in the event of equipment malfunction or loss of fuel.

e. Once the heater is in full operation, an additional safety control will shut off the flow of fuel if the unit reaches an overheat temperature of 250° ±6°F (98.9° ±6.7°C).

f. The organizational maintenance paragraphs of this manual contain detailed descriptions of the heater components.

1-8. DIFFERENCES IN MODELS.

This publication covers only Heater, Space, VBM Corporation Model VBM 15-IV, serial numbers 001 through 632. No known differences exist for models in this serial number range.

1-9. TABULATED DATA.

a. Identification. The heater has four major identification plates, as follows:

(1) The U.S. Government data plate (fig. 1-2) lists the heater nomenclature, national stock number, part number, contract number, serial number, and weight.

(2) The wiring diagram plate is mounted on the inside of the top cover panel of the heater.

(3) The electrical schematic plate is mounted on the inside of the solid right side cover panel of the heater.

(4) The instruction plate (fig. 1-1) provides abbreviated operating instructions for the heater.

b. Tabulated Data. Tabulated data applicable to the space heater and its components is given in table 1-1.

c. Electrical Schematic and Wiring Diagram. Refer to figure 1-3 for the electrical schematic diagram. Refer to figure 1-4 for the wiring diagram.

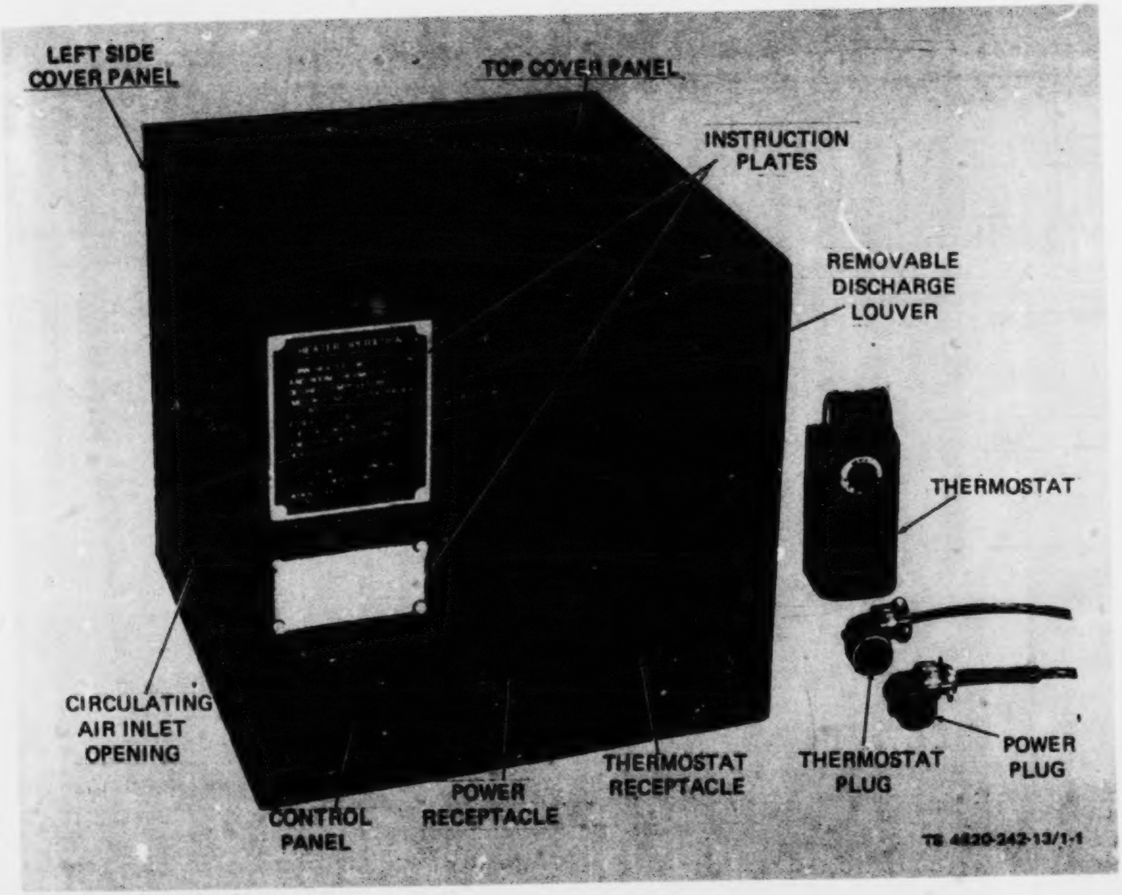

LEFT SIDE COVER PANEL
TOP COVER PANEL
INSTRUCTION PLATES
REMOVABLE DISCHARGE LOUVER
THERMOSTAT
CIRCULATING AIR INLET OPENING
CONTROL PANEL
POWER RECEPTACLE
THERMOSTAT RECEPTACLE
THERMOSTAT PLUG
POWER PLUG
TS 4520-242-13/1-1

Figure 1-1. Multifuel space heater, left front, three-quarter view.

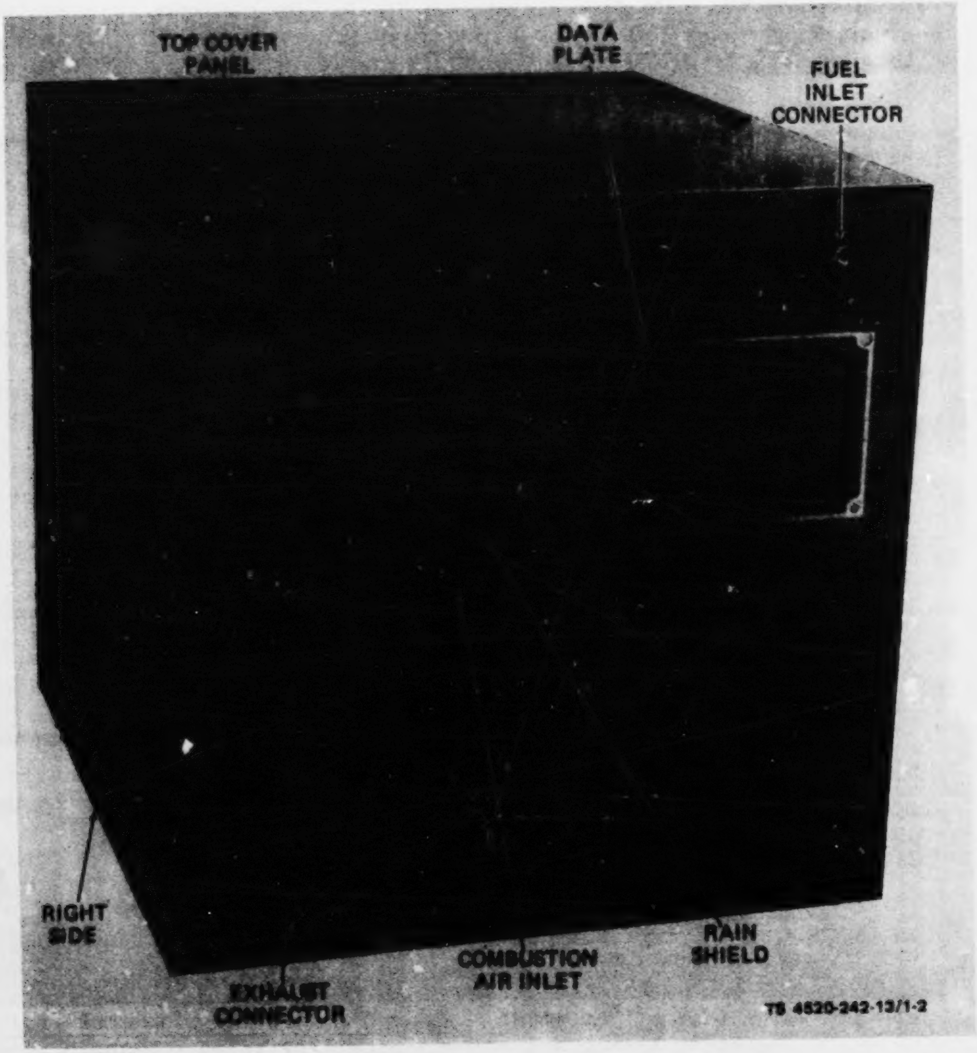
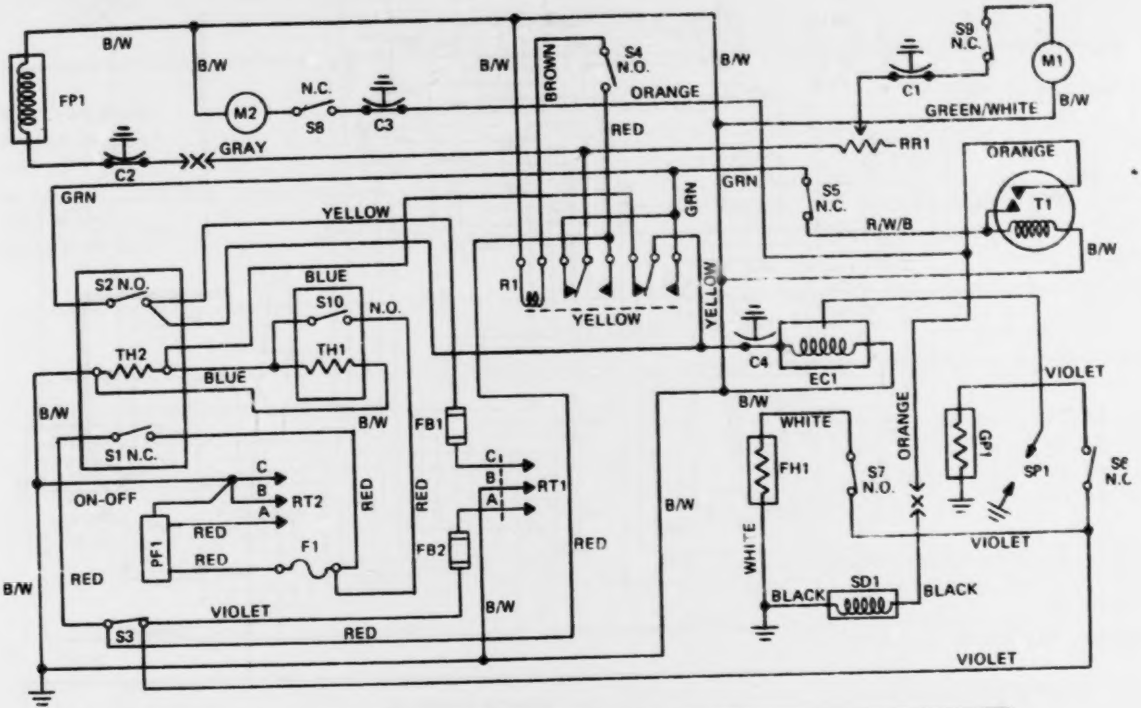

TOP COVER PANEL
DATA PLATE
FUEL INLET CONNECTOR
RIGHT SIDE
EXHAUST CONNECTOR
COMBUSTION AIR INLET
RAIN SHIELD
TS 4520-242-13/1-2

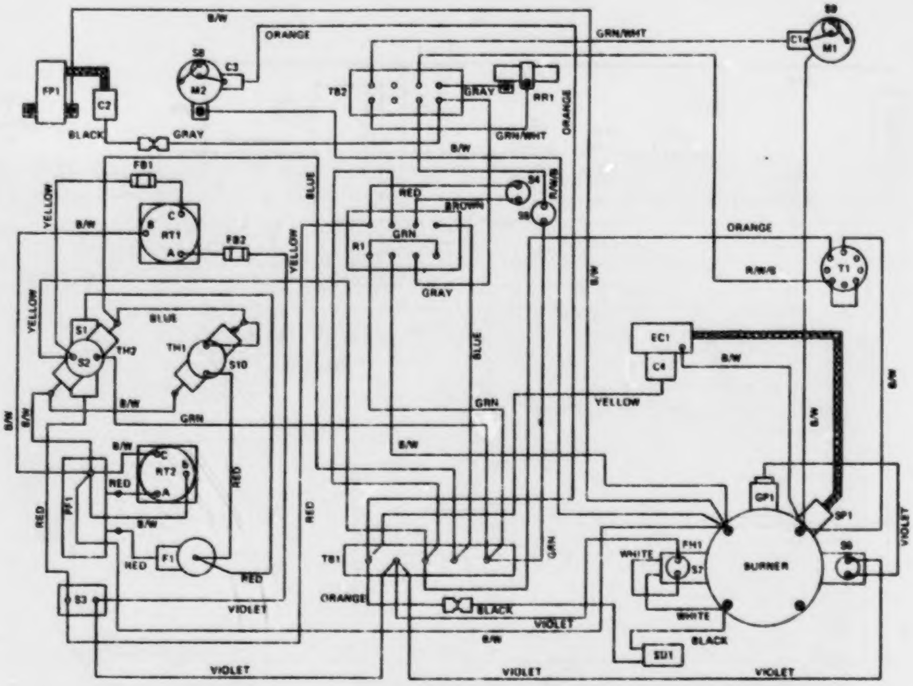
Figure 1-2. Multifuel space heater, right rear, three-quarter view.


B/W
FP1
B/W
M2
N.C.
S8
C3
GRAY
C2
GRN
S4
N.O.
BROWN
ORANGE
RED
B/W
S9
N.C.
M1
C1
GREEN/WHITE
B/W
RR1
ORANGE
GRN
S5
N.C.
R/W/B
T1
B/W
YELLOW
GRN
R1
YELLOW
YELLOW
S2 N.O.
BLUE
S10
N.O.
TH1
TH2
BLUE
C4
EC1
VIOLET
B/W
B/W
WHITE
FH1
S7
N.O.
ORANGE
GP1
SP1
S6
N.C.
S1 N.C.
FB1
C
B
A
RT1
ON-OFF
RT2
RED
RED
PF1
RED
F1
RED
FB2
RED
B/W
WHITE
VIOLET
BLACK
SD1
BLACK
B/W
RED
VIOLET
S3
RED
B/W
VIOLET

KEY TO DIAGRAM			
C1	Capacitor-Vent. & Comb. Motor	S4	Sw. Safety Thermostat
C2	Capacitor-Fuel Pump	S5	Sw. Overheat Thermostat
C3	Capacitor-Compressor	S6	Sw. Glow Plug Thermostat
C4	Capacitor-Ignition Coil	S7	Sw. Fuel Heater Thermostat
F1	Fuse	S8 & S9	Sw. Overheat Protector
FH1	Fuel Heater	S10	Sw. Maintenance Thermostat
FP1	Fuel Pump	SD1	Solenoid
EC1	Ignition Coil	SP1	Spark Plug
GP1	Glow Plug	T1	Timer
M1	Vent. & Comb. Motor	TB1 & TB2	Terminal Block
M2	Compressor	TH1 & TH2	Timer Heater
R1	Relay DPDT	R/W/B	Red, White, Blue
RR1	Resistor	B/W	Black, White
RT1	Receptacle-Thermostat	GRN	Green
RT2	Receptacle-Power 28 V.D.C.	YEL	Yellow
S1	Sw. Reset Thermostat	WHT	White
S2	Sw. Delay Thermostat	FB1 & FB2	Ferrite Beads
S3	Sw. On-Off	PF1	Power Filter

TS 4520-242-13/1-3

Figure 1-3. Electrical schematic diagram.


B/W
ORANGE
GRN/WHT
S9
C1
M1
S8
C3
M2
FP1
C2
TB2
GRAY
RR1
ORANGE
BLACK
GRAY
GRN/WHT
B/W
FB1
YELLOW
B/W
C
B
RT1
A
FB2
BLUE
YELLOW
RED
BROWN
S4
R/W/B
S5
GRN
R1
GRAY
B/W
ORANGE
R/W/B
T1
YELLOW
S1
S2
TH2
BLUE
TH1
S10
BLUE
EC1
C4
B/W
B/W
B/W
GRN
YELLOW
B/W
B/W
GRN
B/W
B/W
C
RT2
B
A
RED
RED
PF1
RED
B/W
RED
F1
RED
RED
TB1
GRN
GP1
SP1
VIOLET
WHITE
FH1
S7
BURNER
S6
S3
VIOLET
ORANGE
BLACK
VIOLET
WHITE
B/W
BLACK
SD1
VIOLET
VIOLET
VIOLET

KEY TO DIAGRAM

C1	Capacitor-Vent. & Comb. Motor	S4	Sw. Safety Thermostat
C2	Capacitor-Fuel Pump	S5	Sw. Overheat Thermostat
C3	Capacitor-Compressor	S6	Sw. Glow Plug Thermostat
C4	Capacitor-Ignition Coil	S7	Sw. Fuel Heater Thermostat
F1	Fuse	S8 & S9	Sw. Overheat Protector
FH1	Fuel Heater	S10	Sw. Maintenance Thermostat
FP1	Fuel Pump	SD1	Solenoid
EC1	Ignition Coil	SP1	Spark Plug
GP1	Glow Plug	T1	Timer
M1	Vent. & Comb. Motor	TB1 & TB2	Terminal Block
M2	Compressor	TH1 & TH2	Timer Heater
R1	Relay-DPDT	R/W/B	Red, White, Blue
RR1	Resistor	B/W	Black, White
RT1	Receptacle-Thermostat	GRN	Green
RT2	Receptacle-Power 28 V.D.C.	YEL	Yellow
S1	Sw. Reset Thermostat	WHT	White
S2	Sw. Delay Thermostat	FB1 & FB2	Ferrite Beads
S3	Sw. On-Off	PF1	Power Filter

TS 4520-242-13/1-4

Figure 1-4. Electrical wiring diagram.

Table 1-1. Tabulated Data

OPERATOR/CREW	
Manufacturer	VBM Corporation
Model number	VBM 15-IV
Volts	28 vdc
Watts	346 max
Btu output	15,000 (3780 kg-c)
Description	Heater, space, multifuel, with blower
ORGANIZATIONAL	
Overall dimensions and weight	
Height	12 in. (30.48 cm)
Width	12 in. (30.48 cm)
Depth	13-3/4 in. (34.93 cm)
Weight	40 lb. (18.14 kg)
Fuel filter	
Manufacturer	Motor Components Division Facet Enterprises, Inc.
Part number	MS51086-1
Type	Strainer element
Heater fuse	
Manufacturer	Littlefuse, Inc.
Part number	307020
Rating	20 amp
Room Thermostat	
Manufacturer	Penn Controls, Inc.
Part number	A19BAB-3
Pilot duty rating	125 volt-amperes
Range	35° to 95°F (1.7° to 35°C)
Spark plug	
Manufacturer	VBM Corporation
Part number	154-216
Glow plug	
Manufacturer	Champion Spark Plug Company
Part number	AG-47
Power requirements	105 watts at 24 volts
ON-OFF switch	
Manufacturer	Cutler-Hammer
Part number	MS35058-22
DIRECT SUPPORT	
Fuel float bowl	
Manufacturer	Marvel Schiebler-Tillotson Division Borg Warner Corporation

Table 1-1. Tabulated Data - Continued

DIRECT SUPPORT - Continued

Part number	013440
Fuel pump	
Manufacturer	Motor Components Division Facet Enterprises, Inc.
Part number	MS51321-1
Type	Electric
Voltage	24 vdc, negative ground
Solenoid valve	
Manufacturer	Acorn Products Corporation
Part number	M21B-1/8-1/8-24VDC
Voltage	24 vdc coil
Coils	
Manufacturer	Guaranteed Parts
Part number	GC-202
Overheat thermostat	
Manufacturer	VBM Corporation
Part number	3100-61-125
Open temperature	250° ±6°F (121.1° ±3.3°C)
Close temperature	210° ±12°F (98.9° ±6.7°C)
Timer (delay relay)	
Manufacturer	Amperite Company
Part number	26N05T
Glow plug thermostat	
Manufacturer	VBM Corporation
Part number	3100-61-116
Open temperature	55° ±5°F (12.8° ±2.8°C)
Close temperature	40° ±5°F (4.4° ±2.8°C)
Fuel heater thermostat	
Manufacturer	VBM Corporation
Part number	3100-61-116
Open temperature	55° ±5°F (12.8° ±2.8°C)
Close temperature	40° ±5°F (4.4° ±2.8°C)
Compressor	
Manufacturer	VBM Corporation
Part number	154-283
Voltage	18/28 vdc
Rating	1 cfm @ 5 psig
Suppression capacitors (motor, compressor, and ignition)	
Manufacturer	Sprague Electric Company
Part number	103P608
Capacitance	0.470 mfd, 100 vdc, 10 amp
Delay thermostat	
Manufacturer	VBM Corporation
Part number	3100-45-114
Open temperature	38° ±5°F (3.3° ±2.8°C)
Close temperature	65° ±5°F (18.3° ±2.8°C)

Table 1-1. Tabulated Data - Continued

DIRECT SUPPORT - Continued	
Blower motor	
Manufacturer	Universal Electric Company
Part number	YZ1U026K
Volts	28 vdc
Rated rpm, full load	4600 ±200 rpm
Flame safety thermostat	
Manufacturer	VBM Corporation
Part number	3100-61-114
Open temperature	90° ±5°F (32.2° ±2.8°C)
Close temperature	110° ±5°F (43.3° ±2.8°C)
Reset thermostat	
Manufacturer	VBM Corporation
Part number	3455RM-77
Open temperature	150° ±10°F (65° ±5.6°C)
Close temperature	Manual reset
Maintenance thermostat	
Manufacturer	VBM Corporation
Part number	3100-61-116
Open temperature	55° ±5°F (12.8° ±2.8°C)
Close temperature	40° ±5°F (4.4° ±2.8°C)
Power filter	
Manufacturer	VBM Corporation
Part number	7673-1F

CHAPTER 2

OPERATING INSTRUCTIONS

INDEX

	Paragraph
Controls and indicators	2-2
Operation	
At high altitudes	2-10
In extreme cold	2-9
Under rainy or humid conditions	2-11
Under usual conditions	2-7
Preparation for use	2-5
Preventive maintenance checks and services	2-3
Servicing standby heater	2-4
Starting	2-6
Stopping	2-8

WARNING

If equipment fails to operate, refer to troubleshooting procedures in Chapter 3.

Section I. DESCRIPTION AND USE OF OPERATOR's CONTROLS AND INDICATORS

2-1. GENERAL. This section contains information and instructions for the personnel responsible for operating this space heater. The information includes the description and function of all controls and indicators.

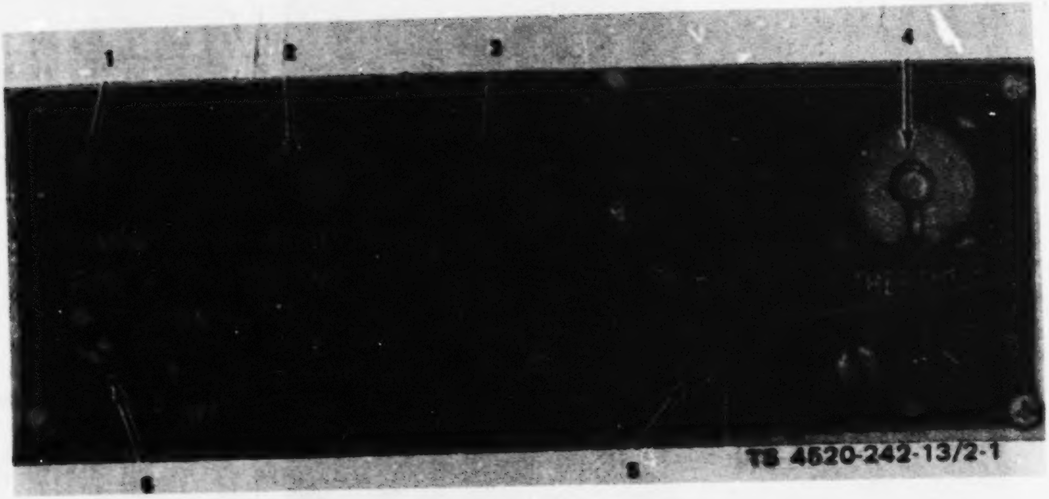
2-2. CONTROLS AND INDICATORS. Before operating the heater, you must become familiar with the controls and indicators provided on the unit. Refer to table 2-1 and to figures 2-1 and 2-2.

Table 2-1. Controls and Indicators

Fig. and item no.	Control or indicator	Function
2-1 1	SPARE FUSE holder	Houses a spare fuse which can be used if the in-circuit fuse blows out.
2-1 2	FUSE holder	Houses the in-circuit fuse to protect electrical circuits from overload.
2-1 3	POWER receptacle	Provides a connector for 28-volt direct current input to the heater.
2-1 4	THERMO receptacle	Provides a connector for the room thermostat which controls heater operation.
2-1 5	RESET button	When button is pressed, a switch resets heater circuits after heater has stopped due to ignition failure or lack of fuel.
2-1 6	ON-OFF switch	Controls starting and stopping of heater. In ON position, heater will start and operate under control of room thermostat. When placed in OFF position, switch stops heater operation. If motor blower is running when switch is moved to OFF, heater will continue to run until cool, then shut off.
2-2	Thermostat knob	Provides a means of selecting the temperature which heater is to maintain in the enclosure. Rotate knob until desired temperature is aligned with index mark.

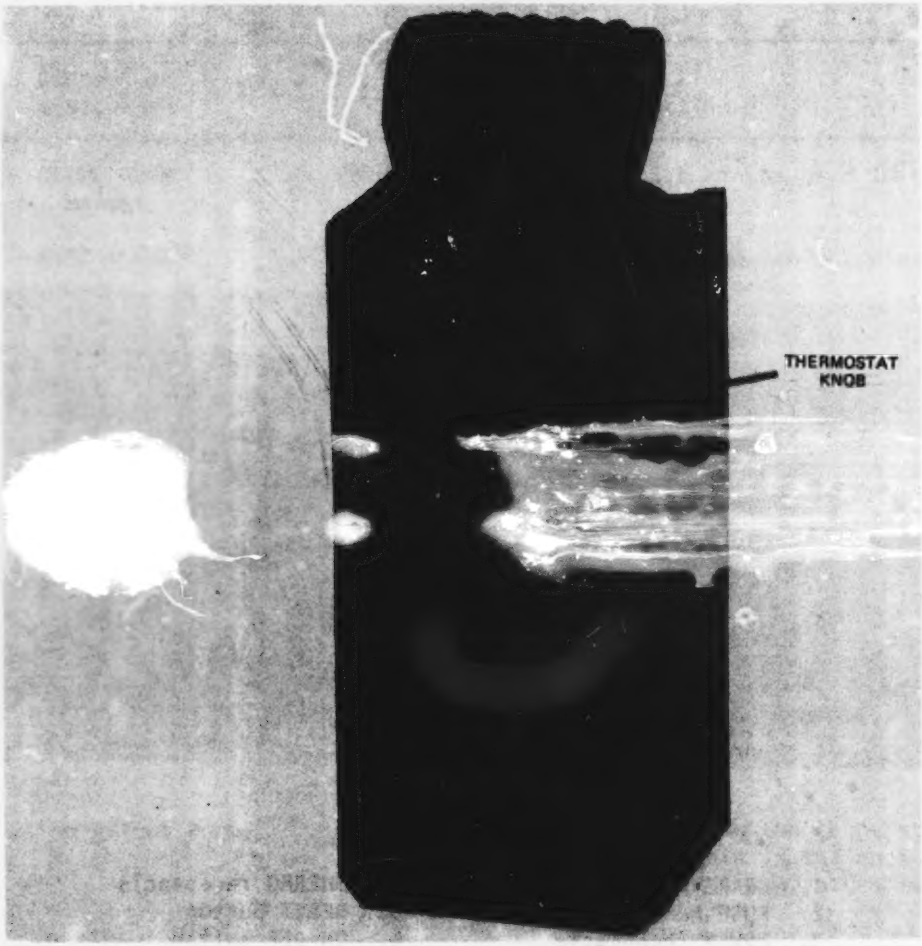
NOTE

The thermostat provides only an on-off control of the heater. Raising the thermostat setting does not increase the heat output of the heater. It causes the heater to run longer to satisfy the heat demand. Setting the thermostat to the highest setting at startup does not increase the rate at which the desired temperature will be reached. To prevent temperature overshoot, set the thermostat only to the temperature desired for the enclosure.


1
2
3
4
6
5
TS 4520-242-13/2-1

1. SPARE FUSE holder
2. FUSE holder
3. POWER receptacle
4. THERMO receptacle
5. RESET button
6. ON-OFF switch

Figure 2-1. Heater controls and connectors.


THERMOSTAT KNOB

TS 4520-242-13/2-2

Figure 2-2. Room thermostat.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-3. GENERAL. The preventive maintenance services to be performed are listed and described in table 2-2. Defects discovered during operation of the unit shall be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noticed which would damage the equipment if operation were continued. To ensure that the space heater is ready for operation at all times, it must be inspected systematically in accordance with the procedural checks and services.

a. Before Your Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) preventive maintenance checks and services.

b. While Your Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) preventive maintenance checks and services.

c. After You Operate. Be sure to perform your after (A) preventive maintenance checks and services.

d. If Your Equipment Fails to Operate. Troubleshoot with proper equipment. Report any deficiencies using the following forms as necessary.

(1) DA Form 2402 (Exchange Tag).

(2) DA Form 2404 (Equipment Inspection and Worksheet).

(3) DA Form 2407 (Maintenance Request Used for Requesting Support Maintenance).

(4) DA Form 2407-1 (Continuation Sheet Used for Requesting Support Maintenance).

For additional forms and records pertaining to your particular equipment, refer to TM 38-750 (The Army Maintenance Manual System [TAMMS]).

e. Recording. The preventive maintenance checks and services in table 2-2 are listed in the item number column according to sequence of performance. Use this column as a source of item numbers for the TM Number column on DA Form 2404, when recording results of preventive maintenance checks and services.

Table 2-2. Operator/Crew Preventive Maintenance Checks and Services

NOTE

Within designated interval, these checks are to be performed in the order listed.

B - Before D - During

Item No.	Interval		Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment is Not Ready/ Available if:
	B	D			
				MAKE THE FOLLOWING WALK AROUND CHECKS:	
1	●		Heater Attachments	a. Check for evidence of leakage (fuel) on or under heater. Check fuel lines for breaks or damage. b. Check fuel tank for proper operating level. Refill as necessary. Open supply valve. c. Check that thermostat and power cable connector are properly connected and cable is not loose, frayed, or pinched.	Leakage is evident.
2		●	Heater Assembly	Check for unusual noises or vibration, improper cycling, or smoking exhaust.	Noisy or vibrating.

2-4. SERVICING STANDBY HEATER.

a. Heaters on standby which have fuel connections and power connections intact must be run periodically to prevent fuel in the lines from losing volatility. Fuel with low volatility will make heater starting difficult or impossible.

b. Every two weeks, run standby heaters long enough to replace residual fuel in the fuel system of each heater to ensure that the heaters will start when they are needed.

Section III. OPERATION UNDER USUAL CONDITIONS

WARNING

> Do not operate this heater in an enclosure unless exhaust gases are piped outside of the enclosure. The exhaust gases contain carbon monoxide, a colorless, odorless, deadly poisonous gas. Failure to provide proper elimination of the exhaust will cause severe illness or death.

2-5. Preparation for Use.

a. Check the fuel supply to see that it is adequate for the period of operation, and verify that the fuel supply valve is open.

b. Check the external fuel lines for leakage or damage. Notify organizational maintenance if any leakage or damage is detected.

c. Check that the power cable plug and room thermostat plug are fully inserted in mating receptacles with threaded swivels tightened.

d. Check the room thermostat setting. If necessary, adjust knob to the desired setting (fig. 2-2).

2-6. Starting.

a. Place the ON-OFF switch (6, fig. 2-1) in the ON position. The heater will operate under control of the room thermostat, starting as the thermostat calls for heat, and stopping as the heat requirement is satisfied. While the heater runs, the blower circulates warm air in the enclosure.

b. If the heater stops after a short time, check for an inadequate fuel supply and replenish if necessary. Allow 3 to 5 minutes for the time delay mechanism to cool, then press the RESET button (5, fig. 2-1) and start the heater in the normal manner.

NOTE

The instruction plate (fig. 2-3) provides abbreviated instructions for operating the heater.

2-7. OPERATION.

a. After starting, the heater will run without operator control, cycling on and off under control of the room thermostat.

b. If the temperature in the enclosure becomes too high or too low, adjust the thermostat knob (fig. 2-2) to compensate.

c. If the type of fuel being used is changed from one operating period to another, the heater may smoke or operate erratically. Report the condition to organizational maintenance for adjustment.

2-8. STOPPING.

a. To stop the heater, turn the ON-OFF switch (6, fig. 2-1) to OFF.

CAUTION

Do not disconnect the power cable connector or interrupt the electrical supply to the heater until it shuts down after the purge cycle is completed.

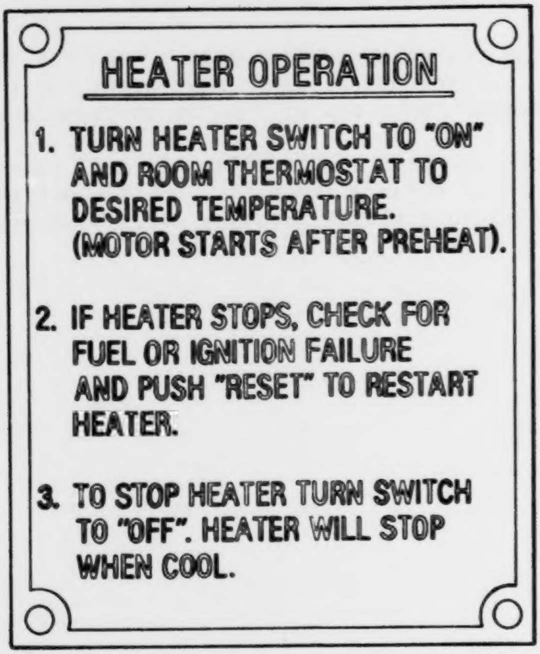
b. If the heater is operating at the time of shutoff, the blower motor will continue to run until all fuel has been purged from the heater. When the fuel is purged and the heater has cooled sufficiently, the heater will shut down.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-9. OPERATION IN EXTREME COLD (BELOW 10°F) (-12.2°C). A thermostatically controlled fuel heater automatically heats the fuel when the temperature drops below 40° ±6°F (1.1° to 7.8°C). This preheating of the fuel aids combustion and ignition during extremely cold conditions. No operating procedures are required for this fuel heater. You should take the following precautions during extremely cold conditions:

a. Keep the fuel tank full to prevent condensation of moisture in the tank.

b. Clean snow and ice from fuel tank filler to prevent them from entering fuel tank, causing freezing in fuel lines.



HEATER OPERATION

1. TURN HEATER SWITCH TO "ON" AND ROOM THERMOSTAT TO DESIRED TEMPERATURE. (MOTOR STARTS AFTER PREHEAT).
2. IF HEATER STOPS, CHECK FOR FUEL OR IGNITION FAILURE AND PUSH "RESET" TO RESTART HEATER.
3. TO STOP HEATER TURN SWITCH TO "OFF". HEATER WILL STOP WHEN COOL.

TS 4520-242-13/2-3

Figure 2-3. Instruction plate.

2-10. OPERATION AT HIGH ALTITUDES.

a. The heater is designed to operate at elevations up to 10,000 feet above sea level without special service or adjustment.

b. At 10,000-foot altitude, heat output may be reduced approximately 15 percen This is a normal condition which cannot be prevented, but optimum performance can obtained by following all service instructions carefully.

2-11. OPERATION UNDER RAINY OR HUMID CONDITIONS.

a. Wipe all accessible exposed areas frequently.

b. Paint all chipped or scratched surfaces to prevent rust.

c. Cover the heater when not in use.

CHAPTER 3

OPERATOR/CREW MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

No lubrication is required.

Section II. TROUBLESHOOTING PROCEDURES

3-1. GENERAL. This section contains troubleshooting information for locating and correcting most of the operating problems which may develop in the space heater.

3-2. OPERATOR/CREW MAINTENANCE TROUBLESHOOTING CHART. Refer to table 3-1 for troubleshooting which is allocated to operator/crew maintenance levels.

a. The table lists the common malfunctions which you may find during the operation or maintenance of the space heater or its components. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed, or is not corrected by the listed corrective actions, notify your supervisor.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 3-1. Operator/Crew Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

1. HEATER FAILS TO START (NO FLAME, NO BLOWER).

Step 1. Check that power is applied to heater.
Connect heater to a source of 28-vdc power. Ensure that power i connected to the POWER receptacle.

Step 2. Check that ON-OFF switch is ON.
Turn switch on.

Step 3. Check room thermostat setting.
Thermostat setting must be higher than ambient temperature of enclosure to start heater operation.

Step 4. Check RESET button.
Press RESET button to reset heater circuit. Start heater by placing the ON-OFF switch in the ON position.

2. HEATER FAILS TO START (NO HEAT; BLOWER RUNS FOR A SHORT TIME, THEN STOPS).

Step 1. Check that fuel tank contains fuel.
Replenish fuel supply.

Step 2. Check that fuel supply has recently been replenished and that it contains no visible contaminants.
Replace fuel in lines and tank if it has become old or contaminated.

3. HEATER OVERHEATS.

Check for airflow restrictions.
Clear area of obstructions to permit free passage of air into and out of heater.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

4-1. INSPECTING AND SERVICING THE EQUIPMENT.

a. Prepare the heater for inspection and operation as outlined on DA Form 2258, Depreservation Guide for Vehicles and Equipment.

b. Inspect the entire heater for lost parts or for damage which may have occurred during shipment.

c. Check the controls for free operation.

d. Inspect for loose or missing hardware.

e. Inspect the thermostat for a broken or loose element.

f. Inspect all tubing, lines and fittings to see that they are secure and free of breaks, kinks, and other damage.

g. Correct all deficiencies or report them to direct support maintenance.

4-2. INSTALLATION OF SEPARATELY PACKED COMPONENTS. The room thermostat and the power and thermostat connectors are separately packed. For installation of these components, refer to paragraph 4-3.

4-3. INSTALLATION OR SETTING UP INSTRUCTIONS.

WARNING

> Do not locate the heater where expelled exhaust gases can be recirculated into inlet air openings of the heated space. Inhalation of exhaust fumes can cause serious illness or death.

a. Location.

(1) Locate the space heater near an outside wall so that the exhaust can be piped to the outside with a short direct run (fig. 4-1). The total length of the horizontal run of the exhaust pipe must not exceed 6 feet.

(2) The space heater should be positioned at approximately the same level as the fuel source and should never be positioned more than 7 feet above the fuel source.

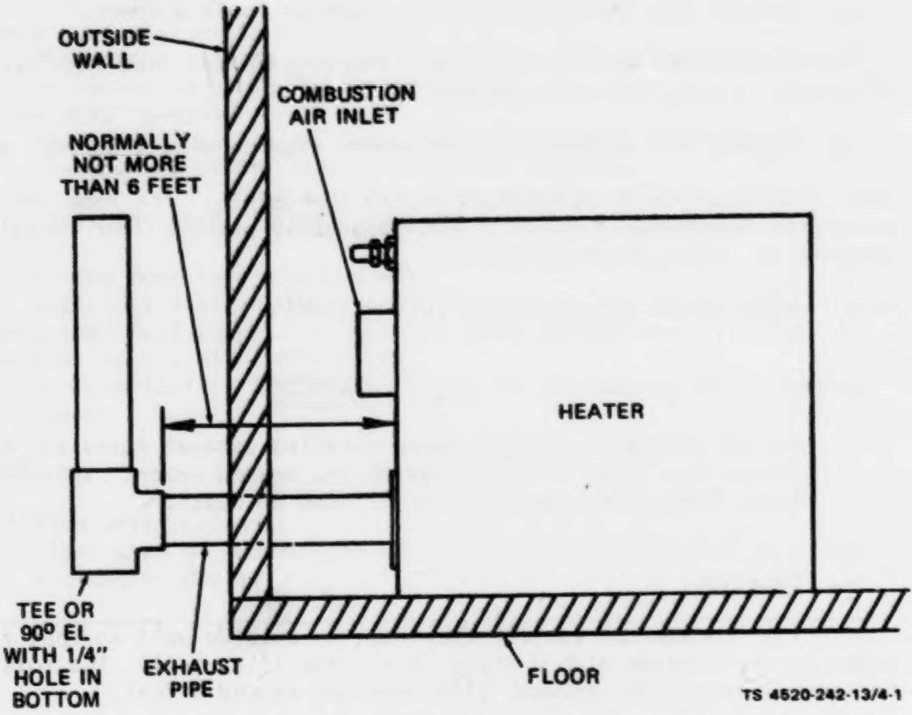

OUTSIDE WALL
COMBUSTION AIR INLET
NORMALLY NOT MORE THAN 6 FEET
HEATER
TEE OR 90° EL WITH 1/4" HOLE IN BOTTOM
EXHAUST PIPE
FLOOR
TS 4520-242-13/4-1

Figure 4-1. Typical exhaust connection.

(3) Refer to figure 4-2 and provide clearances as indicated to permit proper air circulation. Allow adequate room at the front and left side for control access and servicing.

(4) The left side cover panel and the top cover panel are interchangeable to provide alternate air intake installation.

b. Installation.

(1) Secure heater to base or floor using 1/2-20 bolts of suitable length (bolts not furnished with equipment).

NOTE

The space heater should be positioned at approximately the same level as the fuel source and should never be positioned more than 7 feet above the fuel source.

(2) Connect the fuel inlet connector (fig. 4-3) on the heater to the fuel source, using suitable lines and fittings. Make sure that the fuel supply is clean and free of moisture. Check that connections do not leak.

WARNING

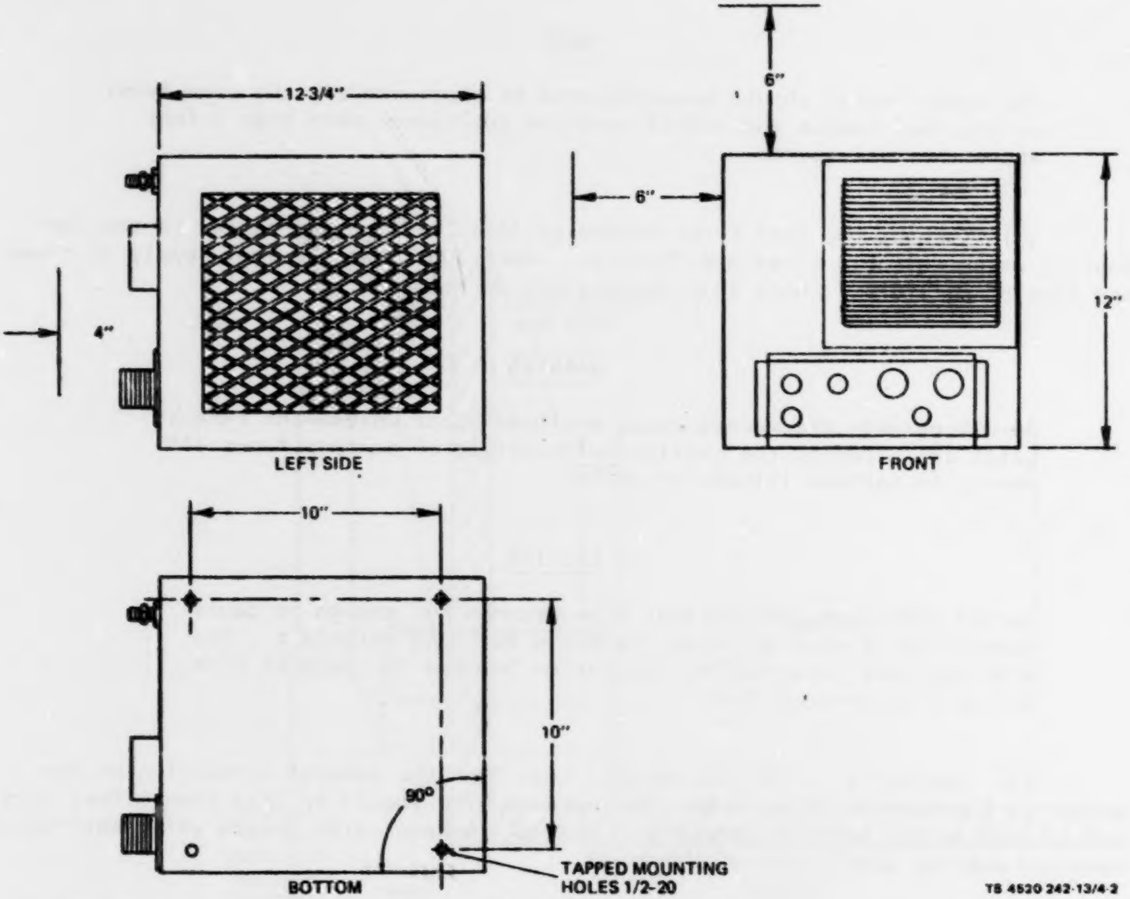
Do not operate the heater in an enclosed space unless the exhaust gases are piped to the outside. Inhalation of exhaust fumes will result in serious illness or death.

CAUTION

During operation, the exhaust pipe becomes hot enough to cause combustion of wood or other flammable building materials. Provide adequate fireproofing insulation between the exhaust pipe and wall to prevent fire.

(3) Connect a 1-1/4-inch exhaust pipe from the exhaust connection on the heater to the outside (fig. 4-1). The exhaust line should be less than 6 feet long and contain as few bends as possible. Seal all exhaust pipe joints using anti-seize compound meeting specification JAN-A-669.

(4) When the heater is operated in a tightly constructed compartment which restricts intake of combustion air, it is recommended that combustion air be connected to the combustion air inlet (fig. 4-3) from an external source. Combustion air piping is necessary to prevent depletion of oxygen in an extremely tight enclosure.


12-3/4"
6"
6"
4"
12"
LEFT SIDE
FRONT
10"
10"
90°
BOTTOM
TAPPED MOUNTING HOLES 1/2-20

TS 4520 242-13/4-2

Figure 4-2. Base plan.

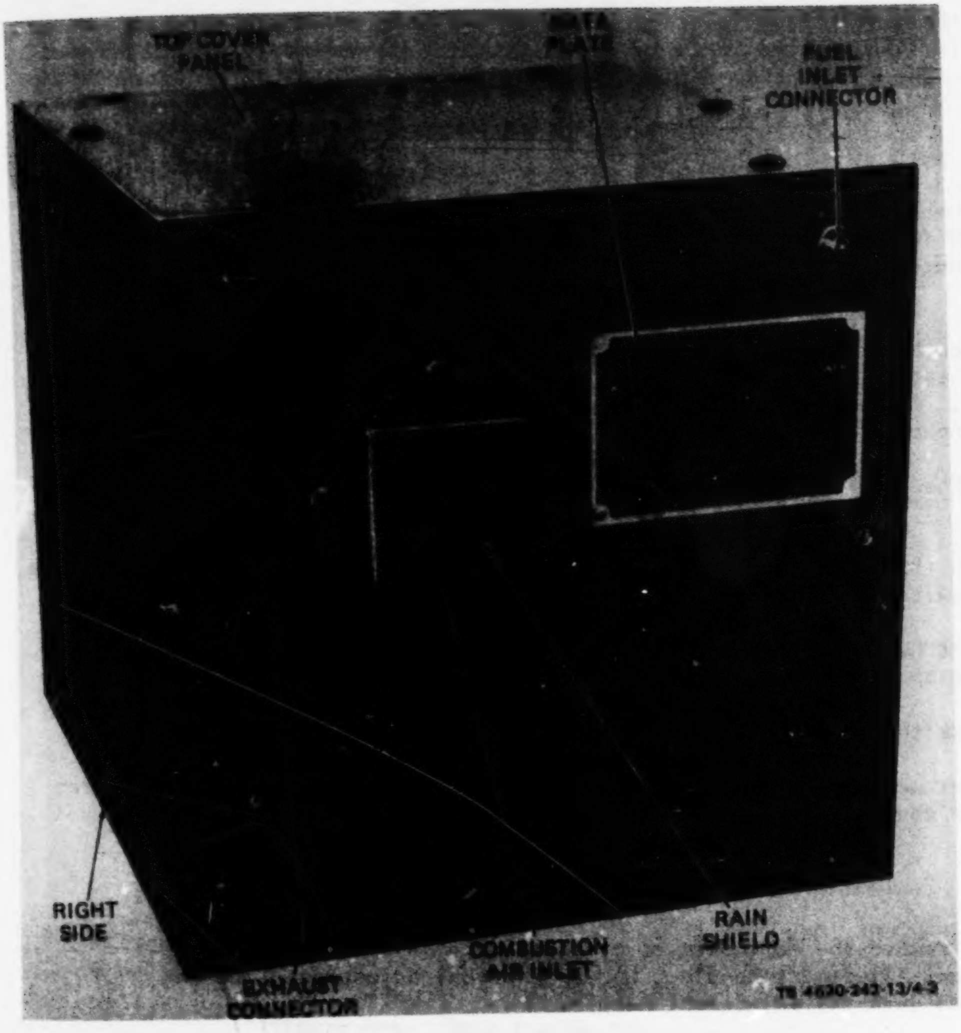

TOP COVER PANEL
DATA PLATE
FUEL INLET CONNECTOR
RIGHT SIDE
EXHAUST CONNECTOR
COMBUSTION AIR INLET
RAIN SHIELD
TS 4520-242-13/4-3

Figure 4-3. Multifuel space heater, right rear, three-quarter view.

(5) Mount the room thermostat (fig. 4-4) in an upright position on an inside or insulated wall in the area to be heated. Do not install the thermostat in line with the heater air inlet or discharge air flow, in a drafty position, or on an outside wall.

(6) Remove the thermostat cover and attach a shield 3-wire cable, long enough to reach between heater and thermostat, secure the cable ground (green) wire to one of the thermostat mounting screws and connect the other two wires (red and black) to the two terminals on the thermostat switch. Attach the other end of the cable to the three-pin room thermostat plug (which is packaged separately). Make sure the ground wire of the cable is connected to the ground lug of the connector (pin B). Connect the connector to the room THERMO receptacle (4, fig. 4-5) on the heater control panel.

NOTE

If the combined length of power cable and thermostat cable does not exceed 20 feet, use 14-gage cable for both applications. If the combined length exceeds 20 feet, use 12-gage cable.

(7) Prepare a dc power cord using a 3-wire cable and the dc connector provided with the heater. The B terminal must be negative (-) and the A terminal must be positive (+). Connect the ground to the C terminal. Connect the cable between the 28-volt dc power source and the POWER receptacle (3, fig. 4-5).

c. Initial Checkout and Adjustment. After installation, check heater operation as follows:

(1) With the thermostat knob (fig. 4-4) set to less than ambient temperature, set the ON-OFF switch (6, fig. 4-5) to the ON position. The heater must not start.

(2) Start heater operation by setting the thermostat knob to a temperature above ambient to cause heater ignition.

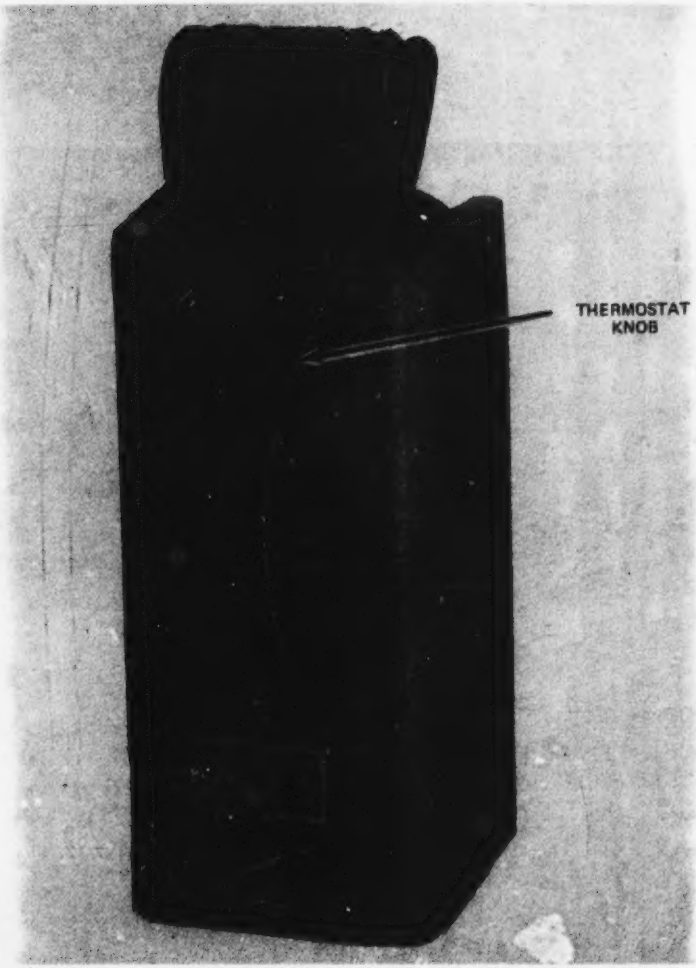
(3) Check that the blower motor starts and that the unit circulates air.

(4) After warmup, check the exhaust for smoke and check for erratic operation. If either condition exists, adjust the fuel adjustment needle.

NOTE

You must remove the left side cover panel (fig. 4-6) to gain access to the fuel adjustment needle. Loosen the fuel adjustment lock nut before you turn the adjustment needle.

(5) If the heater smokes, turn the fuel adjustment needle 1/8 turn clockwise to reduce the fuel flow. Observe heater operation for 1 minute. If smoking persists, turn the needle an additional 1/8 turn and observe the operation. Continue until operation is satisfactory.


THERMOSTAT KNOB

TS 4520 242-13/4-4

Figure 4-4. Room thermostat.

1
2
3
4
TM 4520-242-13/4-5

1. SPARE FUSE holder
2. FUSE holder
3. POWER receptacle
4. THERMO receptacle
5. RESET button
6. ON-OFF switch

Figure 4-5. Heater controls and connectors.

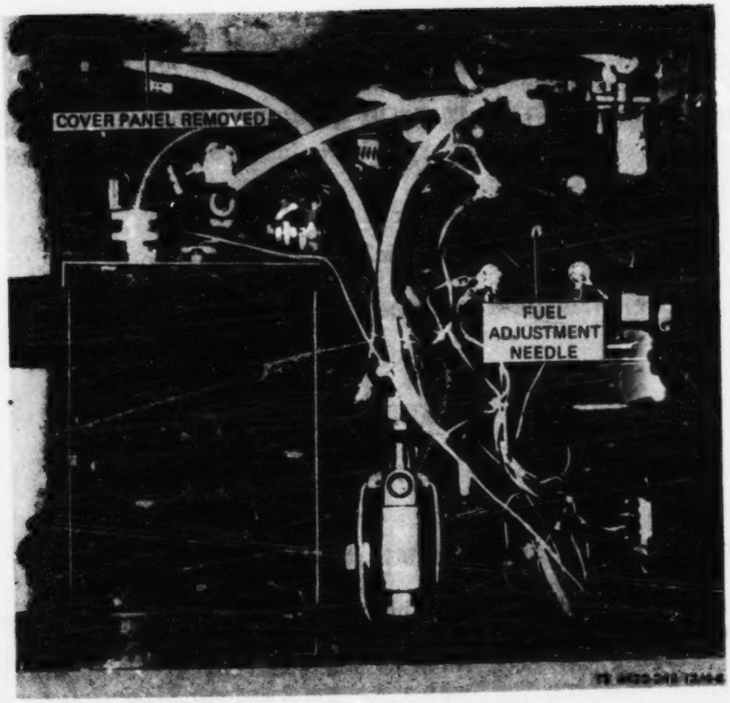

COVER PANEL REMOVED
FUEL ADJUSTMENT NEEDLE

Figure 4-6. Fuel adjustment.

(6) If heater operation is erratic, or if heater fails to operate properly in extremely low ambient temperatures, turn the fuel adjustment needle 1/8 turn counterclockwise to increase fuel flow. Observe operation for 1 minute. Continue to turn the needle counterclockwise in 1/8-turn increments until heater operation is satisfactory. When heater is burning smoothly, there should be little or no smoke from the exhaust outlet, and the heat exchanger tubes should not be red in color.

(7) Check that the heater shuts off when the thermostat set temperature is reached in the enclosure. If conditions permit, check that the unit cycles under control of the room thermostat.

(8) Stop the heater by operating the ON-OFF switch (6, fig. 4-5) to OFF. If the heater is burning when the switch is operated to OFF, the flame will go out immediately, but the blower motor will continue to run until the heat is purged from the burner, after which it will stop.

(9) Refer to table 4-2, Troubleshooting, if the unit fails to operate in the required manner.

Section II. MOVEMENT TO NEW WORKSITE

4-4. DISMANTLING FOR MOVEMENT.

a. Disconnect the fuel line from the fuel inlet connector.

b. Operate the heater until residual fuel is expended, then cap the heater fuel connection.

WARNING

Do not disconnect exhaust pipe until heat has dissipated.

c. Disconnect the exhaust pipe from the exhaust connection.

d. Remove the thermostat; disconnect the thermostat and power cable connectors from mating receptacles on the control panel.

e. Remove the bolts securing the heater to the base or floor.

WARNING

Do not drain fuel in an enclosed area or near an open flame or spark. The fuel is flammable and must be drained in an open area.

f. Drain the fuel pump. Remove the fuel bowl of the fuel filter and tip the heater sideways. After draining, reinstall the fuel bowl of the fuel filter.

g. Remove the slotted plug from the fuel float bowl and tip the heater sideways to drain the fuel.

4-5. REINSTALLATION AFTER MOVEMENT. There are no differences between reinstallation procedures after movement and installation performed to set up the equipment.

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

4-6. SPECIAL TOOLS AND EQUIPMENT. No special tools or equipment is required.

4-7. MAINTENANCE REPAIR PARTS. Repair parts are listed and illustrated in TM 5-4520-242-23P, Repair Parts and Special Tools List.

Section IV. LUBRICATION INSTRUCTIONS

No lubrication is required.

Section V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-8. GENERAL. The preventive maintenance services to be performed are listed and described in table 4-1. It includes and expands upon the preventive maintenance services performed by operator/crew maintenance and includes additional services which are allocated to organizational maintenance. The space heater must be checked and serviced systematically in accordacne with the required procedures.

a. Before You Service. Always keep in mind the CAUTIONS and WARNINGS.

b. While You Test. Always keep in mind the CAUTIONS and WARNINGS.

c. When You Replace. Always keep in mind the CAUTIONS and WARNINGS.

d. If Your Equipment Fails To Operate. Troubleshoot with proper equipment. Report any deficiencies using the following forms, as required.

(1) DA Form 2402 (Exchange Tag).

(2) DA Form 2404 (Equipment Inspection and Worksheet).

(3) DA Form 2407 (Maintenance Request Used for Requesting Support Maintenance)

(4) DA Form 2407-1 (Continuation Sheet Used for Requesting Support Maintenance).

For additional forms and records pertaining to your particular equipment, refer to TM 38-750 (The Army Maintenance Manual System [TAMMS]).

e. Recording. The preventive maintenance checks and services in table 4-1 are listed in the item number column according to sequence of performance. Use this column as a source of item numbers for the TM Number column on DA Form 2404 when recording results of preventive maintenance checks and services.

Table 4-1. Organizational Preventive Maintenance Checks and Services

S-Semiannually

Item No.	Interval	Item to be Inspected	Procedures
	S		
			NOTE Perform operator/crew PMCS prior to or in conjunction with organizational PMCS.
1	●	Exterior of heater	a. Check case, panels, and louver for damage and missing or broken parts. b. Check data and instruction plates for damage and legibility.
2	●	Electrical panel	Check panel for missing or damaged fuses. Replace if damaged or missing.
3	●	Fuel Pump	Check fuel pump for loose or missing screws. Tighten loose screws, replace broken or missing screws. WARNING Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat.
4	●	Fuel Filter	Clean fuel filter with cleaning solvent.
5	●	Burner	Check burner for tears, holes, loose or missing parts, and damage. Refer to direct support for repair.

All data on pages 4-14 through 4-16 deleted.

Table 4-1. Organizational Preventive Maintenance Checks and Services, Quarterly Schedule - Continued

Item no.	Item to be inspected	Procedures	For readiness reporting, equipment is not ready/ available if:
	Burner-Continued		
8	Glow Plug-Continued	damage. Apply 28 vdc across the glow plug leads and check that the glow plug heats. Replace a damaged or defective glow plug. Replace the power plug.	
9	Air Combustion Tube	Inspect for tears, holes, collapsed walls, and for loose or missing hose clamps. Tighten or replace hose clamps. Replace defective air tube.	
10	Ignition Cable	Inspect for damaged shielding and broken connections. Report any defects to direct support maintenance.	Damage is visible.
	Fuel System		
11	Fuel Tubing and Fittings	Remove the left side cover panel of the heater. Inspect for leakage, damage, and tightness of fittings and tubing. Tighten fittings to stop leaks, and replace damaged tubing.	Fittings are damaged or leakage persists after fittings are tightened.
12	Fuel Float	Inspect for leaks, fitting thread damage, and loose screws. Tighten loose screws.	Cover or body is cracked, threads are damaged, or screws are missing.
13	Solenoid Valve	Inspect for damaged electrical leads and fuel leakage.	Leads are damaged, or there is evidence of fuel leakage.
14	Fuel Filter	Inspect for dents, cracks and leaks. Check filter and bowl for contamination. Loosen the nut on the fuel filter bail. Swing the bail aside and remove the fuel bowl, gasket, and filter element. Replace damaged parts.	
15	Fuel Pump	Inspect for secure mounting and fuel leakage. Check for proper operation. Tighten loose mounting screws. Service fuel pump filter as follows: Disconnect the power plug and remove the left side cover panel. Shut off the fuel supply line and disconnect the fuel supply line at the bulkhead	Damage or leakage is visible, or if fuel pump is inoperative.

Table 4-1. Organizational Preventive Maintenance Checks and Services, Quarterly Schedule - Continued

Item no.	Item to be inspected	Procedures	For readiness reportin equipment is not ready available if:
	Fuel System-Continued		
15	Fuel Pump-Continued	fitting. Remove the control panel as far as the wires will permit. Remove the two screws, nuts, and washers securing the fuel pump to the heater case. Pull the fuel pump toward the control panel opening. Use a small container to catch the fuel, and remove the fuel pump cover and filter. Clean the filter using dry cleaning solvent. Reassemble all parts in the order of removal.	

Section VI. TROUBLESHOOTING

4-9. GENERAL.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the space heater. The table lists the common malfunctions which you may find during the operation or maintenance of the space heater or its components. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

c. Only those functions which are solely within the scope of organizational maintenance are listed.

4-10. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING CHART.

Refer to table 4-2 for troubleshooting which is allocated to organizational maintenance levels.

NOTE

Before you use this table, be sureyou have performed all applicable operating checks.

Table 4-2. Organizational Maintenance Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be extremely careful when making voltage measurements or other checks with the heater connected to the power source during troubleshooting. Always disconnect the power cable connector before making any continuity tests.

1. HEATER FAILS TO START (NO FLAME, NO BLOWER).

Step 1. Check that fuse is not blown.
Replace blown fuse. Push in the cap on the fuse holder and rotate the fuse. Insert new fuse.

Step 2. Inspect room thermostat wiring for loose connections.
Tighten loose connections or repair broken leads.

Step 3. Turn on the ON-OFF switch. Set thermostat to its highest setting, remove cover, and jump thermostat terminals with an insulated screw driver.
If heater starts when terminals are jumped, replace thermostat as follows:
Remove the thermostat cover and attach a shielded 3-wire cable, long enough to reach between heater and thermostat. Secure the cable ground (green) wire to one of the thermostat mounting screws, and connect the other two wires (red and black) to the two terminals on the thermostat switch. Attach the other end of the cable to the three-pin room thermostat plug. Make sure the ground wire of the cable is connected to the ground lug of the connector (pin B). Connect the connector to the room THERMO receptacle (4, fig. 4-5) on the heater control panel.

NOTE

If the combined length of power cable and thermostat cable does not exceed 20 feet, use 14-gage cable for both applications. If the combined length exceeds 20 feet, use 12-gage cable.

Table 4-2. Organizational Maintenance Troubleshooting - Continued

---

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

2. HEATER FAILS TO START (NO HEAT; BLOWER RUNS UNTIL RESET SWITCH TRIPS).

Step 1. Remove filter element (fig. 4-7) by loosening the nut on the fuel filter bail. Swing the bail aside and remove the filter.
Check filter element for contamination. Replace parts in reverse order of removal.

Step 2. Check that power is available to fuel pump (11, fig. 4-8) and solenoid valve (10).
If no power is available, check electrical connections.

Step 3. Disconnect fuel tube at float bowl (8, fig. 4-8) inlet and turn on power. Fuel should flow from fuel tube.
Check power input to fuel pump. Report to direct support maintenance if power is available but no fuel flows from fuel tube.

Step 4. Remove the spark plug (4, fig. 4-8) and check for damage.
Replace a damaged spark plug.

Step 5. Remove glow plug (5, fig. 4-8). Apply 28 vdc across the glow plug leads.
Replace glow plug if it fails to heat.

Step 6. Remove main fire tube inspection plug from burner (6, fig. 4-8). Turn on power, and check that fuel flows into main fire tube.
If no fuel flows, report to direct support maintenance.

3. HEATER OVERHEATS, CYCLING UNDER CONTROL OF OVERHEAT THERMOSTAT.

Step 1. Check for restricted air flow.
Remove any obstacles restricting air flow.

Step 2. Check for high fuel flow rate (indicated by heat exchanger tubes being red in color).
Reduce fuel rate.

4. HEATER BACKFIRES.

Step 1. Check that fuel adjustment is correct.
Adjust fuel adjustment needle as follows:

NOTE

You must remove the left side cover panel (fig. 4-9) to gain access to the fuel adjustment needle. Loosen the fuel adjustment lock nut before you turn the adjustment needle.

If the heater smokes, turn the fuel adjustment needle 1/8 turn clockwise to reduce the fuel flow. Observe heater operation for 1 minute. If smoking persists, turn the needle an additional 1/8 turn and observe the operation. Continue until operation is satisfactory.

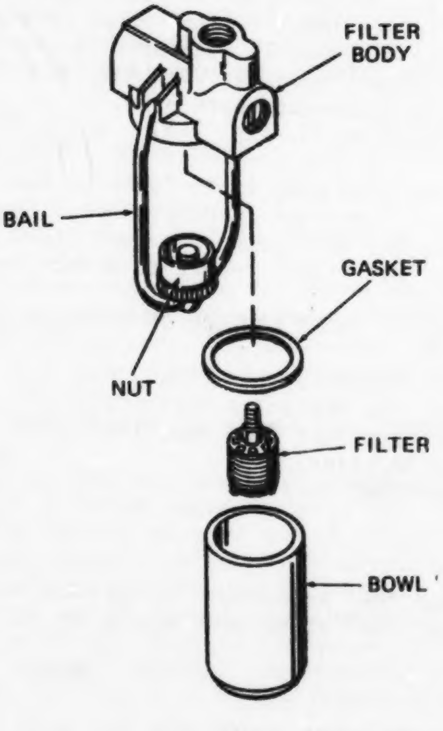
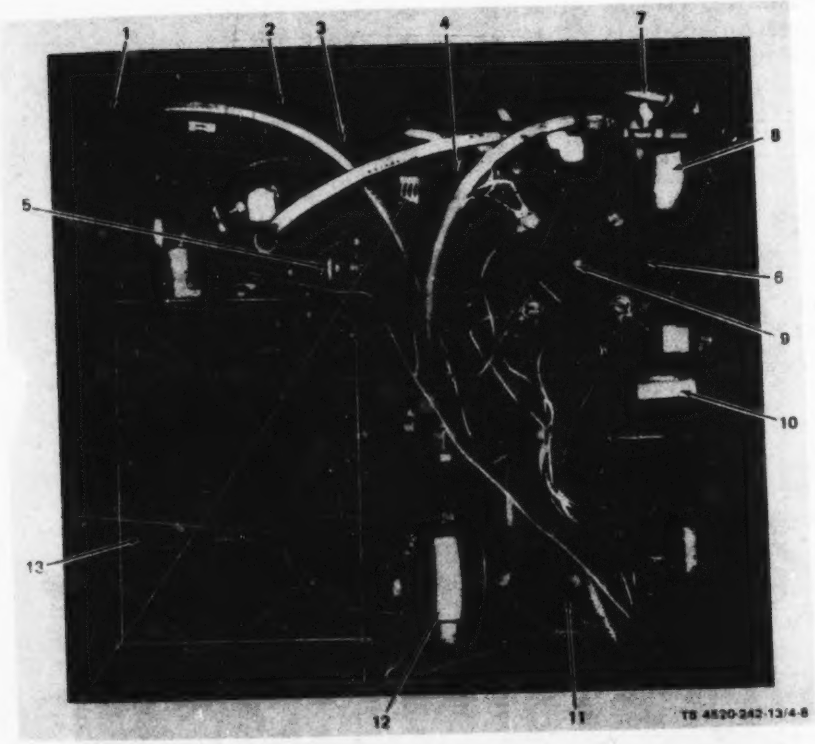

FILTER BODY
BAIL
GASKET
NUT
FILTER
BOWL
TS 4520-242-13/4-7

Figure 4-7. Fuel filter.


1
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3
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11
TS 4520-242-13/4-8

1. Fuel inlet bulkhead fitting
2. Combustion air tube
3. Ignition cable
4. Spark plug
5. Glow plug
6. Burner
7. Vent tube
8. Fuel float bowl
9. Fuel adjustment needle
10. Solenoid valve
11. Fuel pump
12. Fuel filter
13. Ignition case

Figure 4-8. Side view of heater showing internal components.

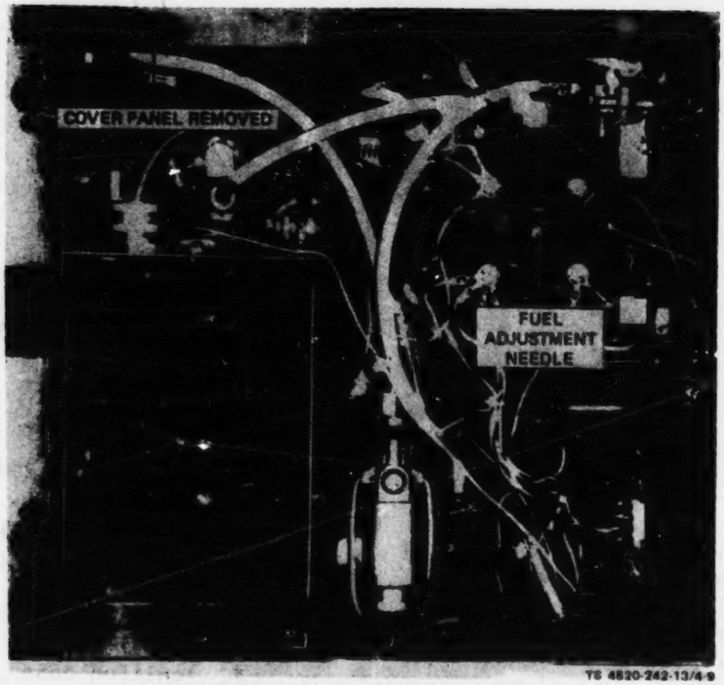

COVER PANEL REMOVED
FUEL ADJUSTMENT NEEDLE
TS 4520-242-13/4-9

Figure 4-9. Fuel adjustment.

Table 4-2. Organizational Maintenance Troubleshooting - Continued

---

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

4 - Continued

If heater operation is erratic, or if heater fails to operate properly in extremely low ambient temperatures, turn the fuel adjustment needle 1/8 turn counterclockwise to increase fuel flow. Observe operation 1 minute. Continue to turn the needle counterclockwise in 1/8-turn increments until heater operation is satisfactory. When heater is burning smoothly, there should be little or no smoke from the exhaust outlet, and the heat exchanger tubes should not be red in color.

CAUTION

When checking spark, do not exceed the 1/8 inch (3 mm) distance from grounded surface. Any greater distance will cause excessively high potential buildup resulting in insulation breakdown either internally or in the ignition cable. Make sure there are no fuel and fumes in the area of grounded surface that could ignite when checking spark.

Step 2. Remove ignition cable from the spark plug and position cable so that cable end is 1/8 inch (3 mm) from a grounded surface. Turn on power.
If spark is weak or intermittent, report to direct support maintenance.

Step 3. Remove spark plug and check for damage.
Replace a damaged spark plug.

Step 4. Check exhaust system for obstructions.
Remove exhaust obstructions.

Step 5. Check that exhaust piping is installed correctly.
Revise exhaust piping to conform to figure 4-10.

Step 6. Check that combustion air damper is opened sufficiently to provide adequate combustion air.
Adjust the air damper nut so that air damper will have 5/16-inch (8 mm) clearance from the side of the intake housing when the damper is in the open position.

5. HEATER CYCLES ON AND OFF EXCESSIVELY.

Step 1. Check that room thermostat is installed correctly.
Relocate improperly installed thermostat. Mount the room thermostat in an upright position on an inside or insulated wall in the area to be heated. Do not install the thermostat in line with the heater air inlet or discharge air flow, in a drafty position, or on an outside wall.

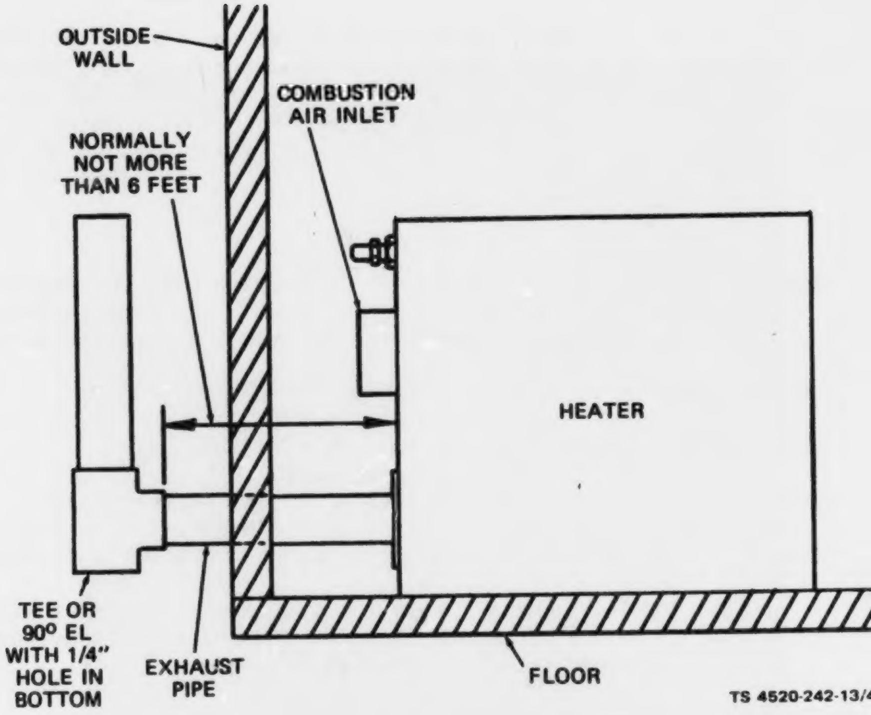

OUTSIDE WALL
COMBUSTION AIR INLET
NORMALLY NOT MORE THAN 6 FEET
HEATER
TEE OR 90° EL WITH 1/4" HOLE IN BOTTOM
EXHAUST PIPE
FLOOR
TS 4520-242-13/4

Figure 4-10. Exhaust installation.

Table 4-2. Organizational Maintenance Troubleshooting - Continued

---

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

5 - Continued

Step 2. Disconnect thermostat power cable from thermostat. Use a multimeter set to read 1X resistance and check continuity across thermostat contacts while operating thermostat temperature control. Continuity must be made sharply as temperature control is moved up to and past ambient temperature. Continuity must be broken sharply as temperature control is moved down to and past ambient temperature.

Replace thermostat if contact operation is intermittent or erratic.

6. HEATER SMOKES.

Step 1. Check that fuel adjustment is correct.

Adjust fuel adjustment needle.

Step 2. Check that combustion air inlet is not blocked or dirty.

Clean or repair combustion air inlet or replace damaged parts. Adjust damper to provide adequate combustion air.

Step 3. Check that combustion air damper is opened sufficiently to provide adequate combustion air.

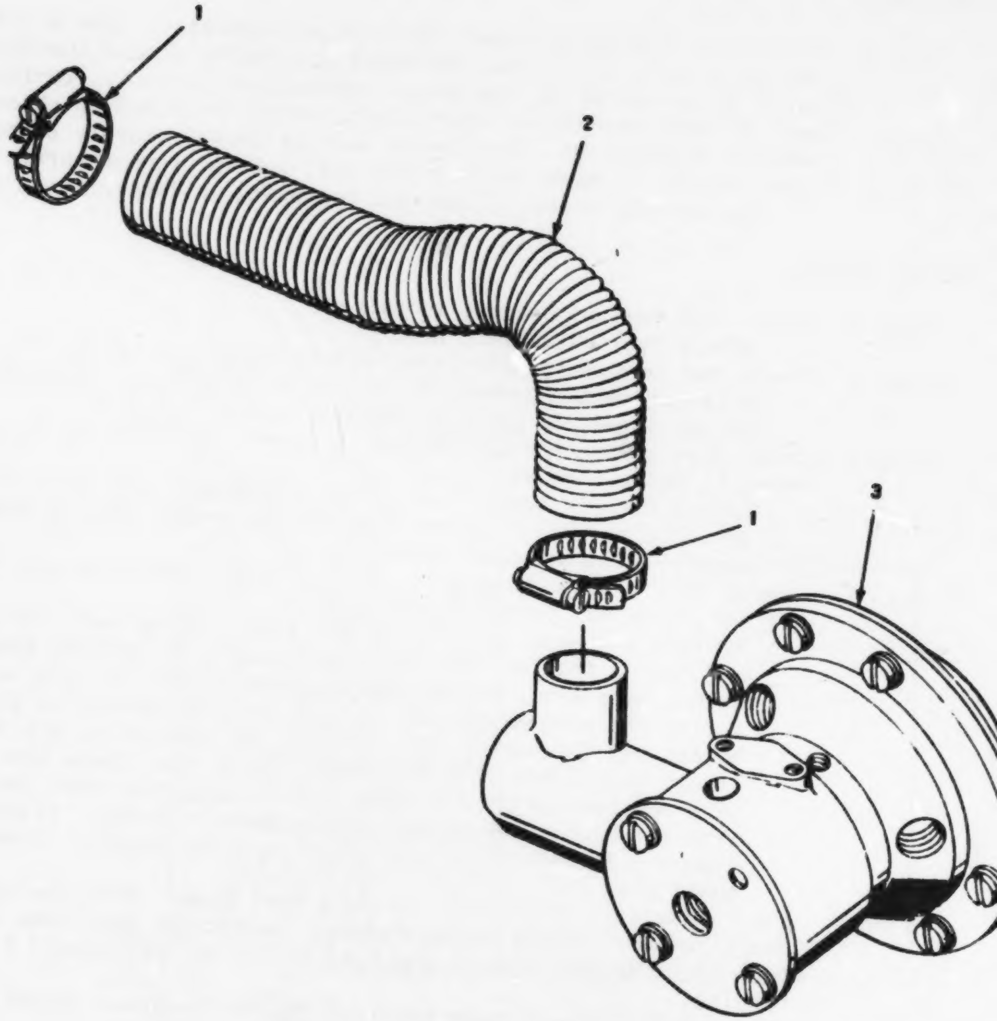
Adjust the air damper nut so the air damper will have 5/16-inch (8 mm) clearance from the side of the intake housing when the damper is in the open position.

Step 4. Remove left side cover panel and check that combustion air tube (2, fig. 4-11) is not torn or restricted.

Replace a damaged combustion air tube. Disconnect the power plug and remove the top and side cover panels to provide access to the burner assembly. Loosen the two hose clamps (1, fig. 4-11) securing the combustion air tube (2) to the combustion air blower outlet and the burner (3). Remove the combustion air tube, and remove the clamps from the tube. Slide the clamps over the ends of a new combustion air tube, and fit the tube over the combustion air blower outlet and the burner air inlet. Tighten the clamps. Reinstall the top and side cover panels. Connect the power plug.

Step 5. Check that fuel float bowl controls fuel flow. With the heater energized and the fuel pump running, remove the vent tube (7, fig. 4-8) from the top side of the fuel bowl. No fuel should flow through opening.

If fuel flows through opening, report to direct support maintenance.


1
2
1
3
TS 4520 242 13/4

1. Hose clamp
2. Combustion air tube
3. Burner assembly

Figure 4-11. Combustion air tube installation.

Section VII. RADIO INTERFERENCE SUPPRESSION

4-11. GENERAL METHODS USED TO ATTAIN PROPER SUPPRESSION. Essentially, suppression is attained by providing a low resistance path to ground for stray currents. The methods used include shielding the ignition wires; installing capacitors on the ignition power supply, blower motor, and air compressor; and installing a power filter in the control panel.

4-12. PRIMARY INTERFERENCE SUPPRESSION COMPONENTS.

a. Three 0.47 microfarad, 200 vdc capacitors are used for primary interference suppression. One is installed on the ignition power supply. This capacitor suppresses the radio frequency interference of the ignition system. The other two capacitors suppress the radio frequency generated by the arcing of brushes at the motor commutators. One is installed on the blower motor and the other is installed on the air compressor motor.

b. A power filter is installed in the control panel. This device passes direct current but filters out the rf component of the input power.

4-13. REPLACEMENT OF PRIMARY INTERFERENCE SUPPRESSION COMPONENTS. Refer replacement of ignition power supply, blower motor, air compressor suppression capacitors, and control panel power filter to direct support maintenance.

4-14. SECONDARY INTERFERENCE SUPPRESSION COMPONENTS.

a. Component Identification. The secondary suppression components on the space heater are the shielded high tension ignition cable from the power supply to the spark plug and the shielded spark plug.

b. Component Replacement.

(1) The ignition cable is part of the ignition power supply. Refer replacement of the ignition cable to direct support maintenance.

(2) Replace the spark plug if defective.

4-15. TESTING OF RADIO INTERFERENCE SUPPRESSION COMPONENTS. Refer testing of suppression capacitors and power filter to direct support maintenance.

Section VIII. MAINTENANCE OF HEATER CASE

4-16. DESCRIPTION.

a. Cover Panels and Case. The heater case contains and mounts the neater components. The warm air louver, secured with wing head studs, can be rotated to any one of four positions to direct the flow of heated air up, down, or to either side. The top and side cover panels are interchangeable so the circulating air inlet screen can be positioned either on the top or left side, as the heater location requires.

b. Control Panel Assembly. The control panel mounts all of the operator contr and the inlet connectors. It is installed at the lower front of the heater case. Its components are connected into the heater electrical system by solder-type and screw-type connectors.

4-17. COVER PANELS AND CASE.

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

a. Disassembly.

(1) Disconnect the power plug before removing the cover panels, unless yo are going to perform operating tests or adjustment.

(2) The cover panels (1, 6, and 11, fig. 4-12) are secured to the heater (27) with twist-lock type studs (3, 5, 8, 10, 13, and 15). Give each stud a quar turn counterclockwise to release the cover panels.

(3) The louver (16) is secured to the heater case (27) with wing head stu (18). Give each wing head stud a quarter twist counterclockwise to release the l

(4) If the combustion chamber cover (20) is damaged, remove the screws (1 that secure it to the case; remove the combustion chamber cover.

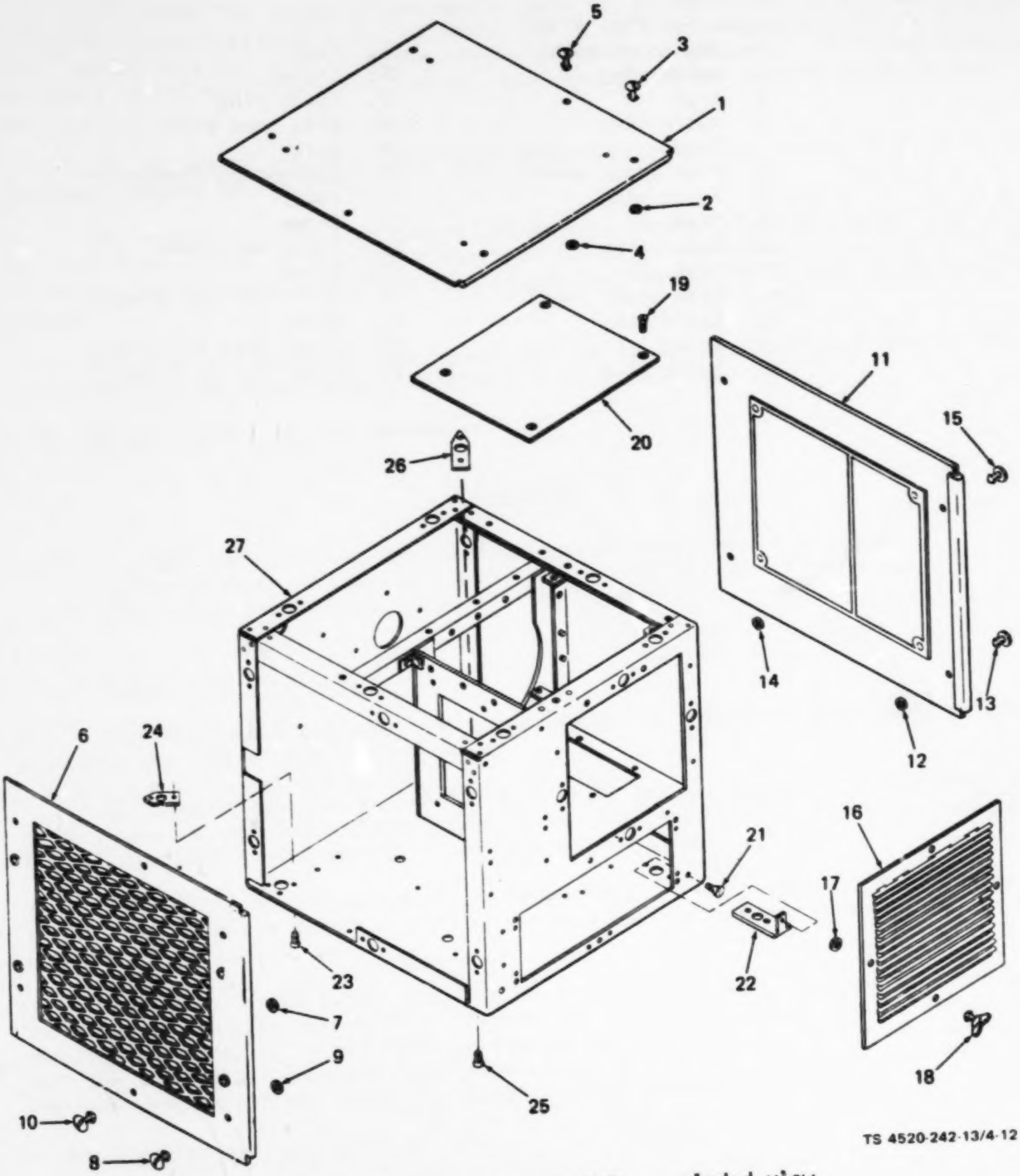
(5) If the nut plates (22, 24, and 26) are damaged, remove the screws (21 23, and 25) that secure them to the case; remove the nut plates.

b. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

(1) Using a dry cloth, wipe dust and lint from the top and side cover pan warm air louver, and combustion air inlet. Remove greasy or gummy deposits with cloth dampened with dry cleaning solvent (fed. spec. P-D-680).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TS 4520-242-13/4-12

Figure 4-12. Heater case assembly, exploded view.

Legend for fig. 4-12:

1. Top cover panel
2. Split ring
3. Stud
4. Split ring
5. Stud
6. Side cover panel
7. Split ring
8. Stud
9. Split ring
10. Stud
11. Side cover panel
12. Split ring
13. Stud
14. Split ring
15. Stud
16. Louver
17. Split ring
18. Wing head stud
19. Screw
20. Combustion chamber cover
21. Screw
22. Front nut plate
23. Screw
24. Left rear nut plate
25. Screw
26. Right rear nut plate
27. Case

(2) Check the inside of the heater case for accumulations of dust and lint. If vacuum cleaning equipment is available, use it to clean the inside of the heater case, taking care not to disturb the wiring or damage components. If vacuum cleaning equipment is not available, use a clean, dry cloth to remove accumulations of dust and lint.

(3) If any of the data plates are defaced or illegible, report the condition to direct support maintenance.

(4) Before reinstalling covers and warm air louver, inspect heater components for fuel leaks, signs of burning or overheating, or other damage or malfunction. Refer to the appropriate repair sections of this publication for repair and replacement procedures.

c. Reassembly. Reassemble the covers and the louver to the heater case in the reverse order of the index numbers in figure 4-12.

4-18. ON-OFF SWITCH AND FUSE HOLDERS.

WARNING

The ignition system of this heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

a. Removal and Disassembly.

(1) Disconnect the power plug, and remove the left side cover panel to provide access to the back of the control panel.

(2) Remove the five screws (1, fig. 4-13) and lock washers (2) securing the control panel assembly (7) to the heater case. Pull out gently on the control panel to provide access to the wiring on the back of the panel.

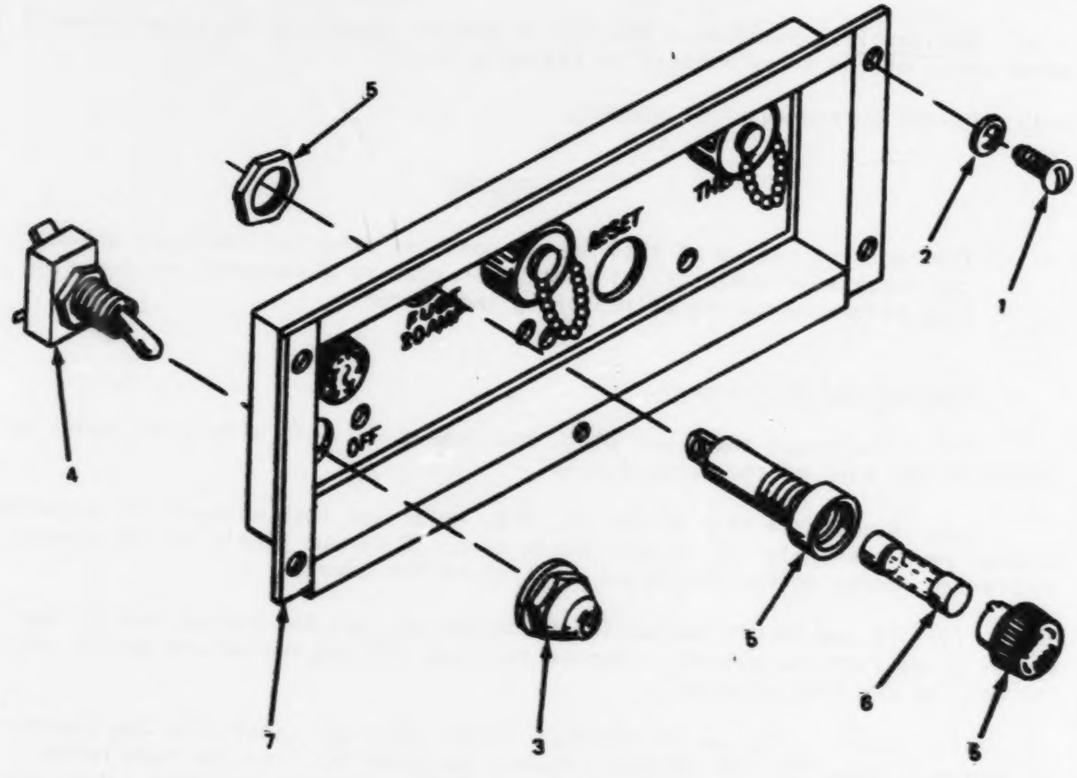
(3) If the ON-OFF switch (4) is defective, tag and remove the two red and two violet leads from the switch. Unscrew the boot (3) and remove the ON-OFF switch from the back of the control panel.

(4) Push in the cap on the fuse holder (5), and rotate the cap counterclockwise to remove it from the fuse holder. Remove the fuse (6) from the fuse holder. Tag and unsolder the three red wires from the fuse holder. Remove the fuse holder nut and pull the fuse holder from the front of the control panel. Remove the spare fuse holder the same way, except the spare fuse holder has no connected wires.

b. Cleaning and Inspection.

(1) Clean the switch and fuse holders with a clean, dry cloth or a soft-bristle brush.

(2) Do not repair the ON-OFF switch or fuse holders. Replace these parts if they are damaged or defective.


5
2
1
4
7
3
5
6
5
FUSE
20AMP
RESET
OFF
TH
TS 4520-242-13/4-13

1. Screw	5. Fuse holder (including nut)
2. Lock washer	6. Fuse
3. Boot	7. Control panel assembly
4. ON-OFF switch	

Figure 4-13. Control panel, exploded view.

(3) Inspect the THERMO and POWER receptacles in the control panel for cracks, damaged terminals, and signs of overheating. Report defective receptacles to direct support maintenance.

c. Reassembly and Installation.

(1) Reassembly of the ON-OFF switch and the fuse holders is the reverse of disassembly. Refer to figure 4-13.

(2) Use only rosin-core solder for soldered connections.

(3) Reinstall the assembled control panel in the heater case and secure with the five screws (1, fig. 4-13) and lock washers (2). Reinstall the side cover panels, connect the power plug, and check heater operation.

Section IX. MAINTENANCE OF ELECTRICAL COMPONENTS

4-19. DESCRIPTION.

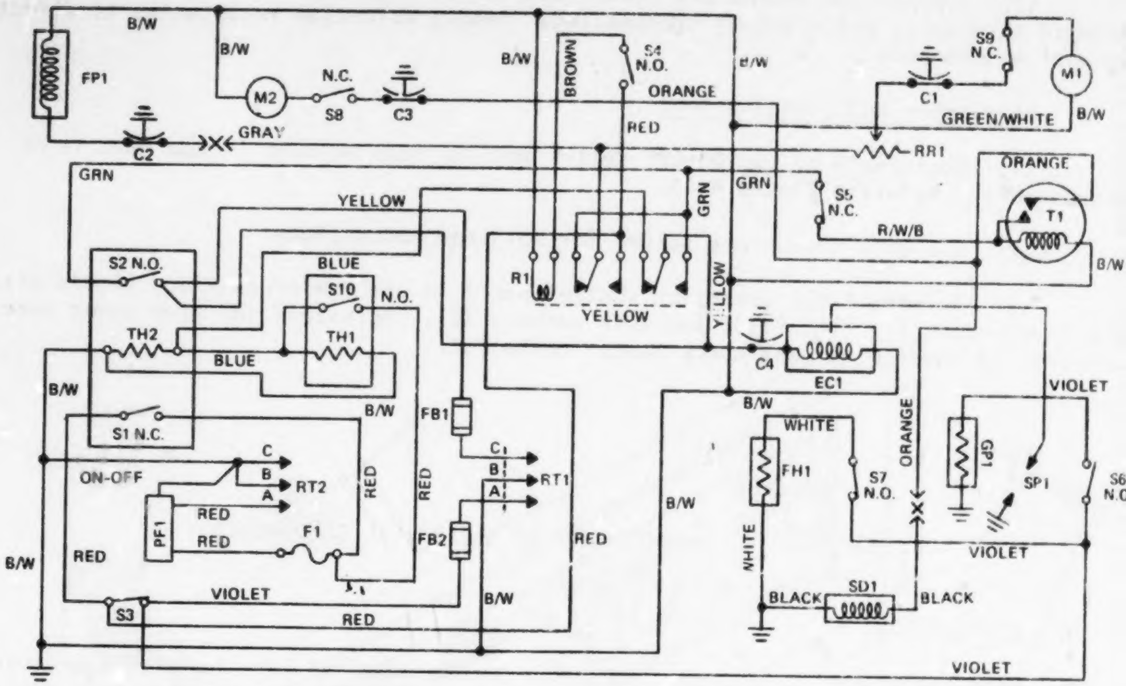
a. Room Thermostat. The room thermostat mounts on a wall in the heated enclosure. It is connected to the heater by a 3-wire cable which plugs into the front of the heater. The thermostat senses the temperature of the air in the enclosure and turns the heater on and off, as long as the ON-OFF switch is on and the heater is supplied with fuel.

b. ON-OFF Switch. The ON-OFF switch is mounted on the control panel and provides the electrical power to operate the thermostat in the automatic mode. When the ON-OFF switch is turned ON, the thermostat will operate the heater automatically to control room temperature.

4-20. ROOM THERMOSTAT.

a. Check the thermostat operation by operating the knob from one extreme to the other, checking that electrical continuity is made as the knob position indicates room temperature and below, and that continuity is broken above room temperature.

b. No repair is authorized for the room thermostat. Replace a defective thermostat as follows:


B/W
FP1
B/W
M2
N.C.
S8
C3
C2
GRAY
GRN
YELLOW
S2 N.O.
BLUE
S10
N.O.
TH1
TH2
BLUE
B/W
S1 N.C.
B/W
C
B
A
RT2
ON-OFF
PF1
RED
RED
F1
RED
RED
FB1
FB2
C
B
A
RT1
RED
VIOLET
S3
RED
B/W
B/W
BROWN
S4 N.O.
ORANGE
RED
GRN
R1
YELLOW
YELLOW
RED
B/W
B/W
S9 N.C.
M1
C1
GREEN/WHITE
B/W
RR1
ORANGE
GRN
S5 N.C.
R/W/B
T1
B/W
C4
EC1
B/W
WHITE
FH1
S7 N.O.
ORANGE
WHITE
BLACK
SD1
BLACK
B/W
VIOLET
GP1
SP1
S6 N.C
VIOLET
VIOLET

KEY TO DIAGRAM

C1	Capacitor-Vent. & Comb. Motor	S4	Sw. Safety Thermostat
C2	Capacitor-Fuel Pump	S5	Sw. Overheat Thermostat
C3	Capacitor-Compressor	S6	Sw. Glow Plug Thermostat
C4	Capacitor-Ignition Coil	S7	Sw. Fuel Heater Thermostat
F1	Fuse	S8 & S9	Sw. Overheat Protector
FH1	Fuel Heater	S10	Sw. Maintenance Thermostat
FP1	Fuel Pump	SD1	Solenoid
EC1	Ignition Coil	SP1	Spark Plug
GP1	Glow Plug	T1	Timer
M1	Vent. & Comb. Motor	TB1 & TB2	Terminal Block
M2	Compressor	TH1 & TH2	Timer Heater
R1	Relay-DPDT	R/W/B	Red, White, Blue
RR1	Resistor	B/W	Black, White
RT1	Receptacle-Thermostat	GRN	Green
RT2	Receptacle-Power 28 V.D.C.	YEL	Yellow
S1	Sw. Reset Thermostat	WHT	White
S2	Sw. Delay Thermostat	FB1 & FB2	Ferrite Beads
S3	Sw. On-Off	PF1	Power Filter

TS 4520-242-13/4-14

Figure 4-14. Electrical system operation.

WARNING

The ignition system of this heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

(1) Mount the room thermostat in an upright position on an inside or insulated wall in the area to be heated. Do not install the thermostat in line with the heater air inlet or discharge air flow, in a drafty position, or on an outside wall.

(2) Remove the thermostat cover and attach a shielded 3-wire cable, long enough to reach between heater and thermostat. Secure the cable ground (green) wire to one of the thermostat mounting screws and connect the other two wires (red and black) to the two terminals on the thermostat switch. Attach the other end of the cable to the three-pin room thermostat plug (which is packaged separately). Make sure the ground wire of the cable is connected to the ground lug of the connector (pin B). Connect the connector to the room THERMO receptacle on the heater control panel. Check heater operation.

NOTE

If the combined length of power cable and thermostat cable does not exceed 20 feet, use 14-gage cable for both applications. If the combined length exceeds 20 feet, use 12-gage cable.

4-21. ON-OFF SWITCH.

a. Check the operation of the ON-OFF switch by operating it from the ON to the OFF position, checking that electrical continuity is made as the switch is placed in the ON position.

b. No repair is authorized for the ON-OFF switch. Replace a defective switch as follows:

WARNING

The ignition system of this heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

(1) Disconnect the power plug, and remove the left side cover panel to provide access to the back of the control panel.

(2) Remove the five screws and lock washers securing the control panel to the heater case. Gently pull out the control panel as far as the wires will permit.

(3) Tag and unsolder two red and two violet leads from the switch.

(4) Unscrew the boot and remove the ON-OFF switch from the back of the control panel.

(5) Replace the switch and reassemble in the reverse order of disassembly.

(6) Replace the power plug and check the operation of the ON-OFF switch.

4-22. DESCRIPTION OF ELECTRICAL SYSTEM OPERATION.

a. Startup.

(1) When the operator turns the ON-OFF switch S3 (fig. 4-14) to ON, current flows to the glow plug thermostat S6 which closes at 40°F (4°C) and passes current to the glow plug GP1 to heat the combustion chamber. Current also flows to the fuel heater thermostat switch S7 which closes at 40°F (4°C) and passes current to the fuel heater FH1.

(2) If the room thermostat contacts are closed, current flows to the delay thermostat S2, ignition coil EC1, spark plug SP1, control relay R1, and timer heaters TH1 and TH2. Maintenance thermostat S10 is constantly supplied current through fuse F1 when the power plug is connected to a source of 28 vdc. Maintenance thermostat S10 closes at 40°F (4°C) to supply a secondary current flow to the two timer heaters TH1 and TH2, which are connected in parallel. With current flow to delay thermostat S2, the time delay cycle begins.

b. Transition.

(1) The delay thermostat S2 is open at room temperature. Heat from timer heater TH2 causes thermostat S2 to close on rising to 65°F (18°C).

(2) When the delay thermostat S2 closes, it passes current to timer T1 and control relay R1. Timer T1, after a slight delay, energizes the fuel solenoid valve SD1, and air compressor motor M2. Relay R1 energizes blower motor M1 and fuel pump FP1, and also opens relay contacts to eliminate the primary current flow to timer heater TH2.

(3) Timer heaters TH1 and TH2 remain energized by the secondary current flow through maintenance thermostat S10 until heater TH1 raises maintenance thermostat S10 temperature to 55°F (13°C).

(4) The combination of heat from the glow plug and spark from the spark plug make possible fuel ignition.

c. Run (Burner Lighted).

(1) If ignition proceeds normally in the transition stage, the heater lights and heat from the burner is detected by flame safety thermostat S4 which closes on rising to 110°F (43°C).

(2) When flame safety thermostat S4 closes, it energizes relay R1. When rel R1 is energized, it bypasses maintenance thermostat S10 and delay thermostat S2.

(3) When energized, relay R1 also sends power to ignition coil EC1, fuel pump FP1, blower motor M1, air compressor M2, and fuel solenoid valve SD1. With the time delay circuit disconnected, the timer heaters shut off and cool, but the flame in the burner is sustained as long as fuel is supplied.

d. Ignition Failure.

(1) If the burner fails to light for any reason, the flame safety thermostat will not actuate the relay, and the contacts will not close. Therefore, relay R1 will not energize to operate the heater in the run stage described in subparagraph c, above.

(2) In this situation, the timer heater will temporarily remain energized. After a total of 60 to 70 seconds, heat from the timer heater will trip RESET switch S1, shutting off all power to the heater and preventing damage to the glow plug or the time delay mechanism.

(3) If the heater runs out of fuel, or if the fuel flow stops for any reason, thermostat S4 and relay will also act to shutoff the heater when the heat exchanger cools.

e. Thermostatic Control.

(1) When ON-OFF switch S3 is turned on, the thermostat will operate the heater automatically to control room temperature. When the room temperature reaches the thermostat setting, the thermostat contacts open, starting the shutdown stage of the heater cycle.

(2) When the room temperature falls below the thermostat setting, the thermostat contacts close, causing the heater to enter the startup stage of its cycle.

(3) The thermostat will continue to turn the heater on and off to control room temperature as long as fuel and power are available to the heater.

f. Shutdown.

(1) When the operator turns ON-OFF switch S3 to OFF, or when the thermostat contacts open, the ignition, air compressor, and fuel solenoid valve circuits are broken, stopping ignition and fuel flow.

(2) Power is still available to flame safety thermostat S4 to keep relay R1 energized. Power is thus available to the relay to run blower motor M1 until all fuel in the burner is consumed. When the flame extinguishes, the blower circulates air to cool the heater.

(3) Air from the blower motor fan cools the heat exchanger until thermostat S4 reaches its cutout setting. The thermostat S4 relay contacts open, deenergizing relay R1. This shuts off power to the motor and prepares the heater for the next startup.

g. Overheat.

(1) If the heater overheats because of reduced ventilation air flow, excessive fuel flow, or other causes, overheat thermostat S5 opens. This breaks the flow of current to the air compressor and the fuel solenoid valve, shutting off the flow of fuel.

(2) Current still flows through relay R1 to operate blower motor M1, cooling down the heat exchanger. When the heat exchanger temperature reaches a safe level, the overheat switch closes to restart fuel flow and ignition. Because the heat exchanger and burner head are still quite warm, ignition is rapid and the time delay assembly is not utilized.

Section X. MAINTENANCE OF BURNER ASSEMBLY

4-23. DESCRIPTION.

a. Combustion Air Tube. The combustion air tube is a spring-wound, neoprene-coated tube which conducts the combustion air from the combustion air blower outlet to the combustion air inlet on the burner.

b. Spark Plug. The spark plug is similar to an automotive spark plug, and it performs a similar function. High voltage from the ignition power supply creates a spark between the spark plug electrode and the grounded burner assembly. It is this spark which ignites the fuel and air mixture in the burner head.

c. Glow Plug. The glow plug is energized when burner casing temperature drops below 40°F (4°C). The glow plug is a wire-wound electrical heater that preheats the burner head to ensure vaporization of the fuel for rapid ignition.

d. Fuel Adjustment Needle. The fuel adjustment needle is located on the burner. It is used to adjust the fuel flow during heater operation or when the type of fuel being burned in the heater is changed.

4-24. COMBUSTION AIR TUBE, SPARK PLUG, GLOW PLUG, AND FUEL ADJUSTMENT NEEDLE.

a. Removal.

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

(1) Disconnect the power plug and remove the top and side cover panels to provide access to the burner assembly.

(2) Loosen the two hose clamps (1, fig. 4-15) securing the combustion air tube (2) to the combustion air blower outlet and the burner. Remove the combustion air tube, and remove the clamps from the tube.

(3) Unscrew the nut on the ignition cable and separate the cable from the spark plug (3). Unscrew the spark plug from the burner (15).

(4) Remove the nut (4) and lock washer (5), and disconnect the purple lead from the glow plug (6). Unscrew and remove the glow plug and gasket (7) from the burner.

(5) Remove screw (8) and lock washer (9) securing the needle retainer (10) to the burner. Remove the fuel adjustment needle assembly by unscrewing pipe plug (11) from the burner. Disassemble fuel adjustment needle assembly by loosening nut (12) and unscrewing needle (13). Remove seal (14).

b. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

(1) Clean the combustion air tube by shaking it or blowing through it with compressed air. Replace the tube if it is torn, deteriorated, restricted, or damaged.

(2) Clean the spark plug, glow plug, and fuel adjustment needle assembly metal parts with dry cleaning solvent (fed. spec. P-D-680). Do not immerse the glow plug in solvent. Allow all parts to dry thoroughly before installation.

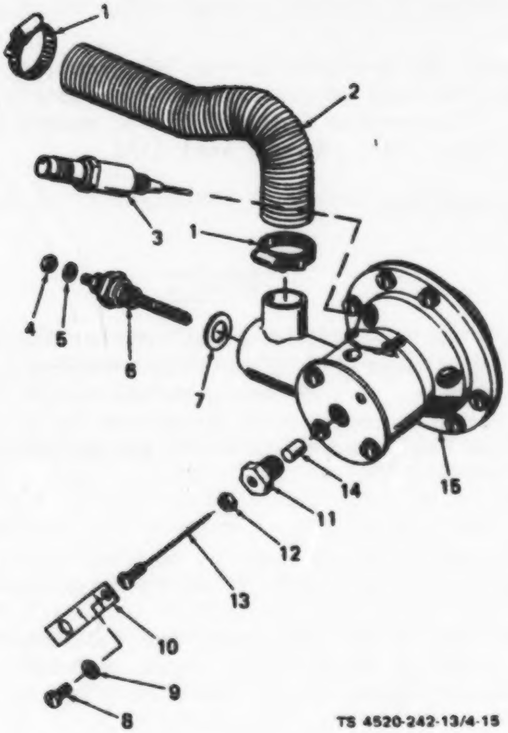
(3) Inspect the electrode and outer shell of the spark plug for burning or pitting. Inspect ceramic parts for cracks or breaks. Inspect threads for damage. Replace a damaged spark plug.

(4) Inspect the glow plug for cracks, frayed insulation, loose or broken leads, defective element winding and other damage. Apply 28 vdc across the glow plug leads and check that the glow plug heats. Replace a damaged or defective glow plug.

(5) Inspect the fuel adjustment needle tip for wear, scoring, or other damage. Replace the fuel adjustment needle if the needle is bent or damaged.

c. Installation.

(1) Reassemble fuel adjustment needle assembly by positioning nut (12) on adjustment needle (13). Install this assembly into pipe plug (11). Carefully slide needle seal (14) over the needle. Turn the fuel adjustment needle into pipe plug (11)



TS 4520-242-13/4-15

1.	Hose clamp	9.	Lock washer
2.	Combustion air tube	10.	Needle retainer
3.	Spark plug	11.	Pipe plug
4.	Nut	12.	Nut
5.	Lock washer	13.	Adjustment needle
6.	Glow plug	14.	Seal
7.	Gasket	15.	Burner
8.	Screw		

Figure 4-15. Burner assembly, exploded view.

until the top of the needle head is 7/16 inch (11 mm) from the face of the pipe plug. Maintain this dimension and tighten nut (12). Coat the male NPT threads of pipe plug (11) with Permatex No. 1, or equivalent, and install the fuel adjustment needle assembly on the burner. Tighten pipe plug until its head is flush to the burner cover plate of burner (15). Position needle retainer (10) over the slotted end of the adjustment needle (13). Secure with lock washer (9) and screw (8).

(2) Use a new gasket (7) and install the glow plug (6) in the burner. Connect the purple lead using lock washer (5) and nut (4).

(3) Install the spark plug (3) in the burner. Position the ignition cable and tighten the ignition cable nut.

(4) Slide the clamps (1) over the ends of the combustion air tube (2), and fit the tube over the combustion air blower outlet and the burner air inlet. Tighten the clamps. Reinstall fuel lines.

(5) Reinstall the top and side cover panels. Connect the power plug and test the heater operation. Adjust the fuel adjustment needle.

d. Fuel Adjustment. When the type of fuel being burned in the heater is changed, or when the heater is subjected to extremely low ambient temperatures, it will normally be necessary to readjust the fuel adjustment needle on the burner assembly for proper combustion.

NOTE

You must remove the left side cover panel to gain access to the fuel adjustment needle. Loosen the fuel adjustment lock nut before you turn the adjustment needle.

(1) If heater smokes, turn the fuel adjustment needle 1/8 turn clockwise to reduce the fuel flow. Observe heater operation for 1 minute. If smoking persists, turn the needle an additional 1/8 turn and observe operation. Continue until operation is satisfactory.

(2) If heater operation is erratic, or heater fails to operate properly in extremely low ambient temperatures, turn the fuel adjustment needle 1/8 turn counterclockwise to increase fuel flow. Observe operation for 1 minute. Continue to turn the needle counterclockwise 1/8 turn until heater operation is satisfactory. When heater is burning smoothly, there should be little or no smoke from the exhaust outlet and the heat exchanger tubes should not be red in color.

Section XI. MAINTENANCE OF FUEL SYSTEM

4-25. DESCRIPTION. The space heater fuel system consists of a fuel float bowl, solenoid valve, fuel filter, fuel pump, and the interconnecting lines and fittings. Refer to figure 4-16.

a. Fuel Float Bowl. The fuel float bowl (8, fig. 4-17) meters the flow of the fuel to the burner head to achieve efficient combustion.

b. Solenoid Valve. The solenoid valve (10) controls the flow of fuel from the fuel float bowl (8) to the fuel nozzle. This electrically controlled device opens the fuel valve when the room thermostat calls for heat and closes the valve when the heat requirement is satisfied.

c. Fuel Filter. The fuel filter (12) traps and holds dirt, moisture, and other contaminants before they enter the heater fuel system. The fuel filter has a metal disc-type element contained in a removable sediment bowl.

d. Fuel Pump. A 28-volt, pulsating-type electric fuel pump (11) draws fuel from the fuel supply and pumps it to the fuel float bowl (8). The pump also contain a filter to remove any contaminants which may have passed through the fuel filter.

e. Fuel Lines. Fixed fuel lines carry the fuel from the fuel filter to the fuel pump. A flexible fuel tube carries the fuel from the fuel pump to the fuel float bowl. A vent tube (3, fig. 4-18) vents excess fuel from the fuel float bowl (4) to the burner (5) in the event of fuel float bowl malfunction. A flexible line carries pressurized air from the compressor to the burner head to atomize fuel.

4-26. FUEL FLOAT BOWL. Inspect the fuel float bowl as follows:

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

a. Remove the top and left side panels from the heater.

b. Check that fuel tube fittings and float bowl cover mounting screws are secure. Tighten loose fittings and screws.

c. Inspect the fuel float bowl for cracks, missing screws, and other visible damage. Report any visible damage to direct support maintenance.

d. Connect the power plug. With the cover panels still removed, start the heat and check for any leaks around the fuel float bowl. If any leakage is detected, shu off the heater, disconnect the power plug, and correct leak. Recheck heater operati and, when it is satisfactory, reinstall cover panels. If leakage cannot be correcte by tightening tube fittings and float bowl cover mounting screws, report condition to direct support maintenance.

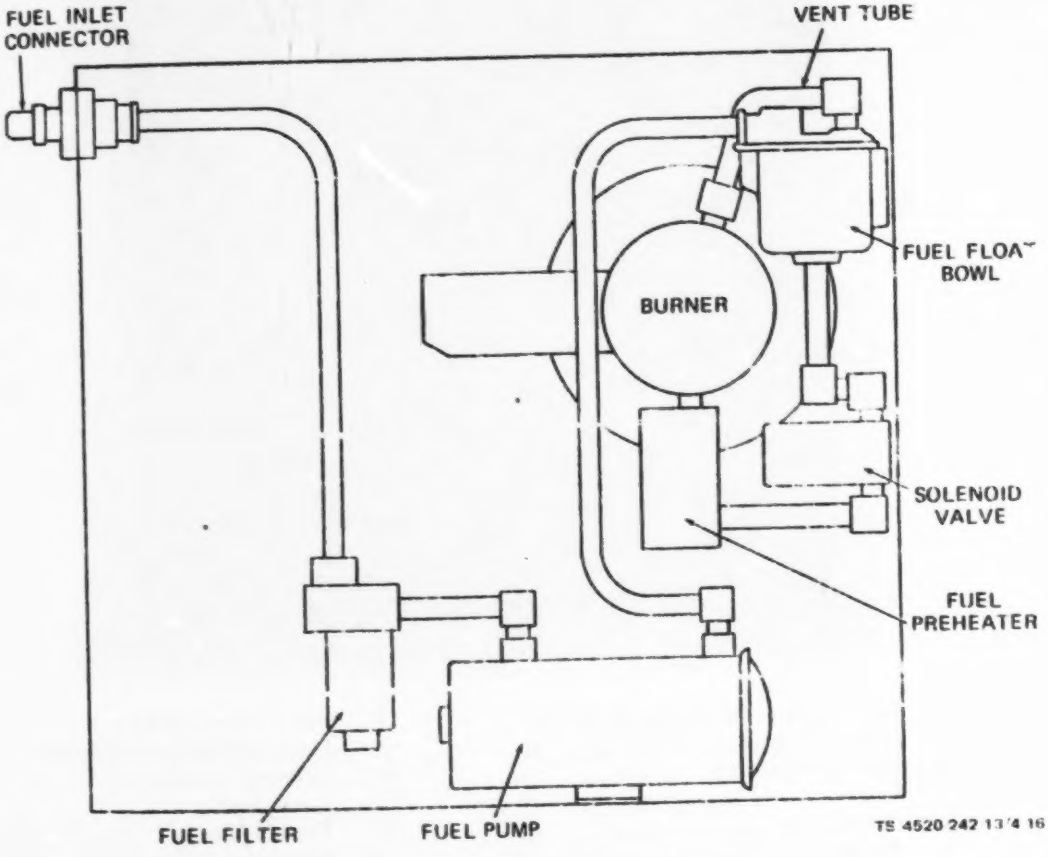

FUEL INLET CONNECTOR
VENT TUBE
FUEL FLOAT BOWL
BURNER
SOLENOID VALVE
FUEL PREHEATER
FUEL FILTER
FUEL PUMP
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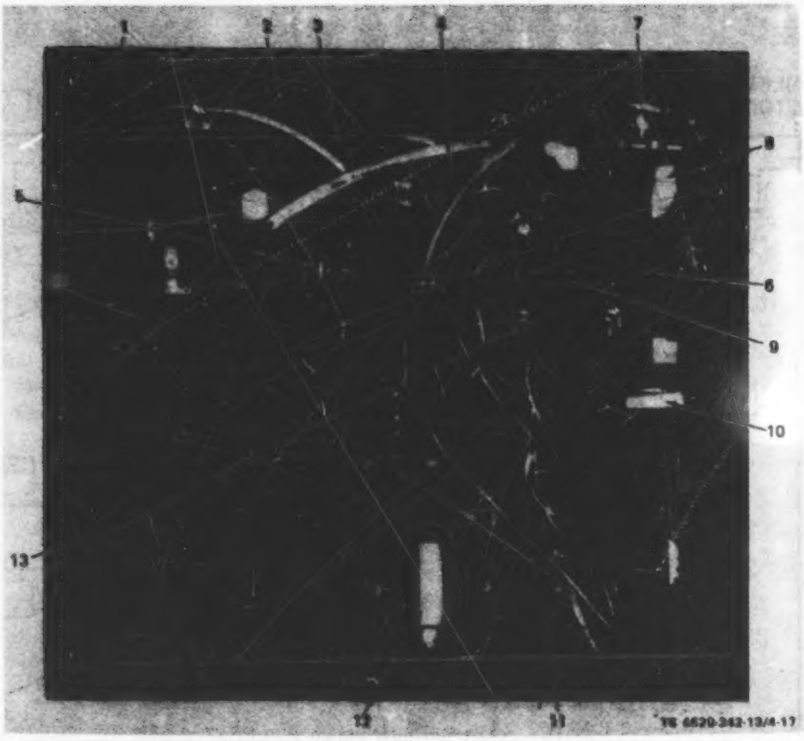
Figure 4-16. Fuel flow diagram.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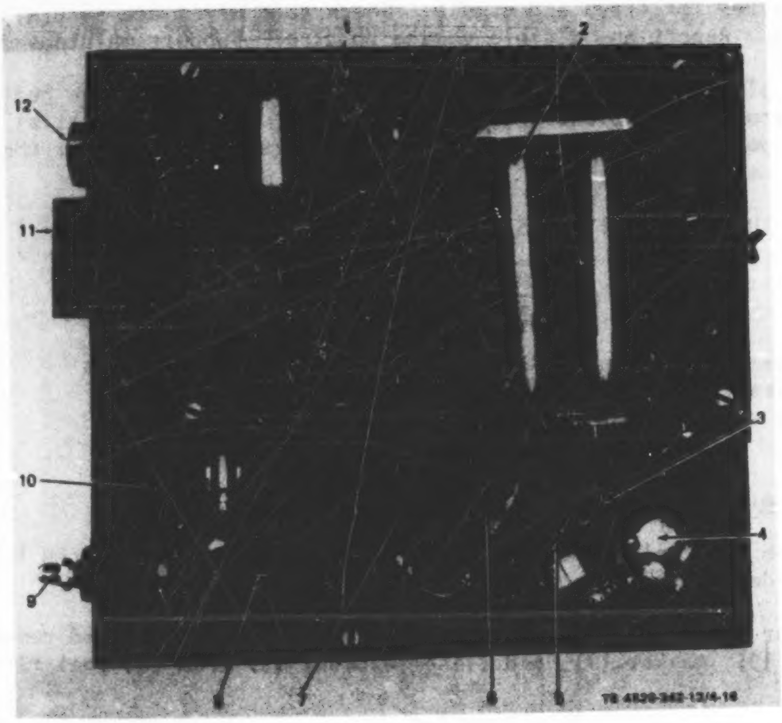
1. Fuel inlet bulkhead fitting
2. Combustion air tube
3. Ignition cable
4. Spark plug
5. Glow plug
6. Burner
7. Vent tube
8. Fuel float bowl
9. Fuel adjustment nee
10. Solenoid valve
11. Fuel pump
12. Fuel filter
13. Ignition case

Figure 4-17. Side view of heater showing interal components.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TS 4520-242-13/4-18

1. Blower
2. Heat exchanger
3. Vent tube
4. Fuel float bowl
5. Burner
6. Spark plug
7. Combustion air tube
8. Fuel inlet tube
9. Bulkhead fitting
10. Air dampener
11. Combustion air inlet
12. Exhaust pipe connector

Figure 4-18. Top view of heater showing internal components.

4-27. SOLENOID VALVE. Inspect the solenoid valve as follows:

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

a. Remove the left side cover panel from the heater.

b. Check that solenoid body nut is secure. Tighten nut if it is loose.

c. Inspect solenoid wires for frays and cracks. Check that wires are securely fastened in solenoid body. Report any visible damage to direct support maintenance.

d. Connect tne power plug. With the cover panel still removed, start the heater and check for any leaks around the solenoid valve. If heater operation is satisfactory, reinstall cover panel. If heater operation is unsatisfactory, report condition to direct support maintenance.

4-28. FUEL FILTER, FUEL TUBES, AND FITTINGS.

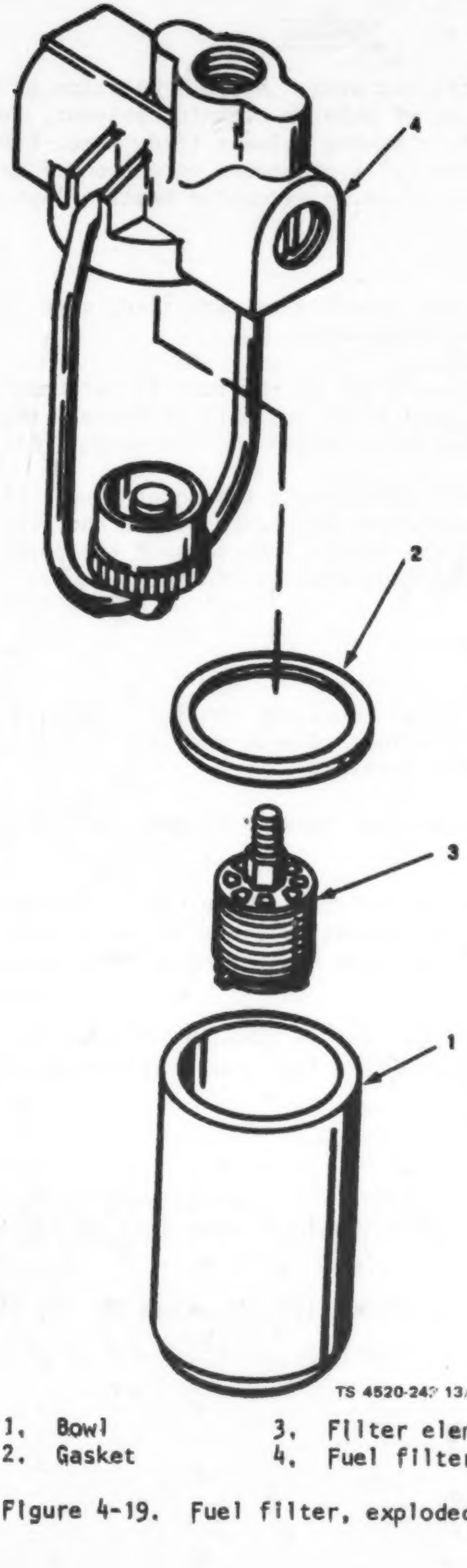
WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

a. Fuel Filter Service.

(1) Disconnect the power plug and shut off the fuel supply. Remove the left side cover panel to provide access to the fuel filter.

(2) Loosen the nut on the fuel filter ball. Swing the ball aside and remove the fuel bowl (1, fig. 4-19), gasket (2), and filter element (3) from the fuel filter body (4).



TS 4520-242 13/4-19

1. Bowl
2. Gasket
3. Filter element
4. Fuel filter body

Figure 4-19. Fuel filter, exploded view.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

(3) Clean the parts with dry cleaning solvent (fed. spec. P-D-680) and allow all parts to dry thoroughly before reassembly.

(4) Install the filter element (3) in the fuel filter body (4). Install the bowl (1), using a new gasket (2), and swing the bail in place. Engage the screw in the notch in the bottom of the bowl and tighten the nut hand tight.

(5) Turn on the fuel supply and connect the power plug. With the cover panel still removed, start the heater and check for leaks around the fuel filter bowl. If any leakage is detected, shut off the heater, disconnect the power plug, and correct the leak. Recheck heater operation and, when it is satisfactory, reinstall the cover panel.

b. Removal.

(1) Disconnect the power plug. Shut off the fuel supply and disconnect the fuel supply line at the bulkhead fitting. Remove the left side cover panel for access to the fuel filter, fuel lines, and fittings.

(2) Disconnect the assembled fuel tube (1 through 3, fig. 4-20), from the fuel filter inlet.

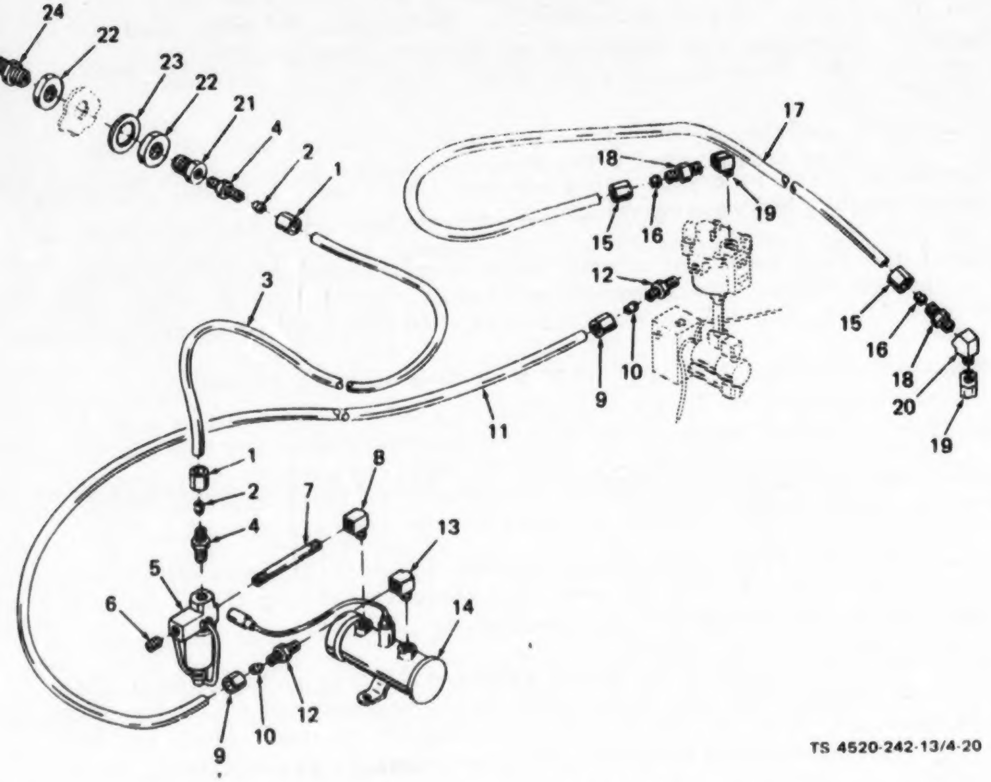
(3) Loosen the nut on the bail of fuel filter (5). Swing the bail aside and remove the fuel bowl (1, fig. 4-19), gasket (2), and filter element (3) from the fuel filter body (4). Unscrew fuel filter body by turning counterclockwise and remove from pipe nipple (7, fig. 4-20).

(4) Remove the assembled fuel tube (9 through 11) from the fuel pump (14) and fuel float bowl. Remove the assembled fuel tube (15 through 17).

NOTE

It is not necessary to disassemble the compression sleeves and compression nuts from the fuel tubes unless the fuel tubes must be replaced.

(5) Unscrew and remove pipe nipple (7), fittings (8, 13, 19, and 20), and connectors (4, 12, and 18).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TS 4520-242-13/4-20

1.	Compression nut	13.	Elbow
2.	Compression sleeve	14.	Fuel pump
3.	Fuel tube	15.	Compression nut
4.	Connector	16.	Compression sleeve
5.	Fuel filter	17.	Vent tube
6.	Plug	18.	Connector
7.	Pipe nipple	19.	Elbow
8.	Elbow	20.	Elbow
9.	Compression nut	21.	Bushing
10.	Compression sleeve	22.	Nut
11.	Fuel tube	23.	Lock washer
12.	Connector	24.	Connector

Figure 4-20. Fuel system, exploded view.

c. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

(1) Clean metal parts in dry cleaning solvent (fed. spec. P-D-680) and a all parts to dry thoroughly before assembly.

(2) Inspect the fuel tubes for cracks, worn spots, restrictions, and oth damage. Replace damaged tubes. The compression sleeves (2, 10, and 16, fig. 4- and compression nuts (1, 9, and 15) must be replaced when the fuel tubes are rep

(3) Replace any fittings that are cracked or have damaged threads.

d. Installation.

(1) Install the fuel tubes, fittings, and fuel filter in the reverse orc the index numbers in figure 4-19.

(2) Use Permatex No. 1, or equivalent, to coat the male NPT threads of t pipe nipple (7) and connectors (4, 12, 18, and 24) before installing them. Do r apply sealing compound to the threads of the compression fittings.

(3) Connect the fuel supply line to the bulkhead fitting and reconnect t power plug. Start the heater with the cover panel still removed and check for l If any leakage is detected, shut off the heater, disconnect the power plug, and rect the leak. Recheck heater operation and, when operation is satisfactory, re stall the cover panel.

4-29. FUEL PUMP. Service the fuel pump filter as follows:

WARNING

The ignition system of this heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before servicing or repairing the heater.

NOTE

You can service the fuel pump filter without removing the fuel pump from the heater case.

a. Disconnect the power plug. Remove the left side cover panel for access to the fuel pump. Shut off the fuel supply and disconnect the fuel supply line at the bulkhead fitting. Disconnect exhaust pipe. Remove the control panel from the heater case. Pull gently on the control panel to prevent damaging the wires.

CAUTION

Have container available to catch fuel when fuel pump cover is removed.

b. Remove the two screws (1, fig. 4-21), nuts (2), and lock washers (3) securing the fuel, pump, fuel pump cable, and wire (4) to the heater case.

c. Pull the fuel pump towards the control panel opening to gain access to the cover (5). Remove the cover, gasket (6), and filter element (7) from the fuel pump (8).

WARNING

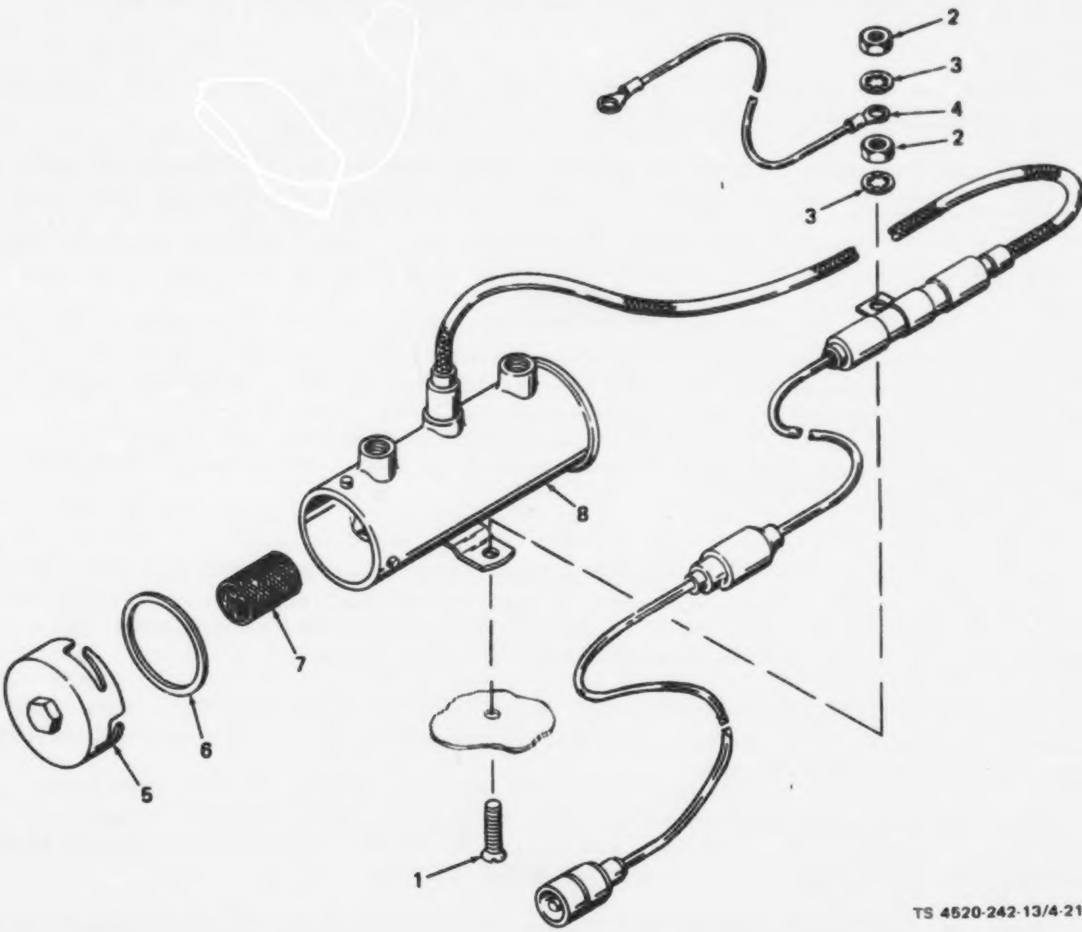
Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

d. Clean the parts with dry cleaning solvent (fed. spec. P-D-680) and allow all parts to dry thoroughly before reassembly. Replace the fuel pump filter element if it cannot be cleaned with cleaning solvent, or if it is cracked or damaged. Check the magnet in the cover to make sure all metal chips are removed.

e. Install the filter element (7, fig. 4-21) into the fuel pump (8). Make sure the filter element is fully seated, and install the cover (5) using a new gasket (6). Secure the cover to the fuel pump.

f. Position fuel pump over mounting holes in heater case. Install screws (1), nuts (2), lock washers (3), wire (4), and fuel pump cable. Install the control panel and connect the fuel supply line to the bulkhead fitting.

g. Open the fuel supply valve, and connect the power plug and exhaust pipe. With the cover panel still removed, start the heater and check for leaks around the fuel pump filter cover. If any leakage is detected, shut off the heater, disconnect the power plug, and correct the leak. Retest heater operation and, when it is satisfactory, reinstall the cover panel.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1. Screw
2. Nut
3. Lock washer
4. Wire
5. Cover
6. Gasket
7. Filter element
8. Fuel pump

Figure 4-21. Fuel pump filter, exploded view.

CHAPTER 5

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

5-1. TOOLS AND EQUIPMENT. The equipment issued with the heater assembly is illustrated in figure 1-1.

5-2. SPECIAL TOOLS AND EQUIPMENT. No special tools or equipment is required for direct support maintenance of the heater assembly.

5-3. MAINTENANCE REPAIR PARTS. Repair parts and equipment are listed and illustrated in the repair parts and special tools list covering direct support maintenance for this equipment. Refer to TM-5-4520-242-23P.

Section II. TROUBLESHOOTING

5-4. GENERAL.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the space heater. Each malfunction is followed by a list of tests or inspections which will help you determine probable causes and corrective actions to take. Perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor. Only those functions which are solely within the scope of direct support maintenance are listed.

5-5. DIRECT SUPPORT MAINTENANCE TROUBLESHOOTING CHART. Refer to table 5-1 for troubleshooting which is allocated to direct support maintenance levels.

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be extremely careful when making voltage measurements or other checks with the heater connected to the power source during troubleshooting. Always remove the power plug before making any continuity tests.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 5-1. Direct Support Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

1. HEATER FAILS TO START (NO FLAME, NO BLOWER).

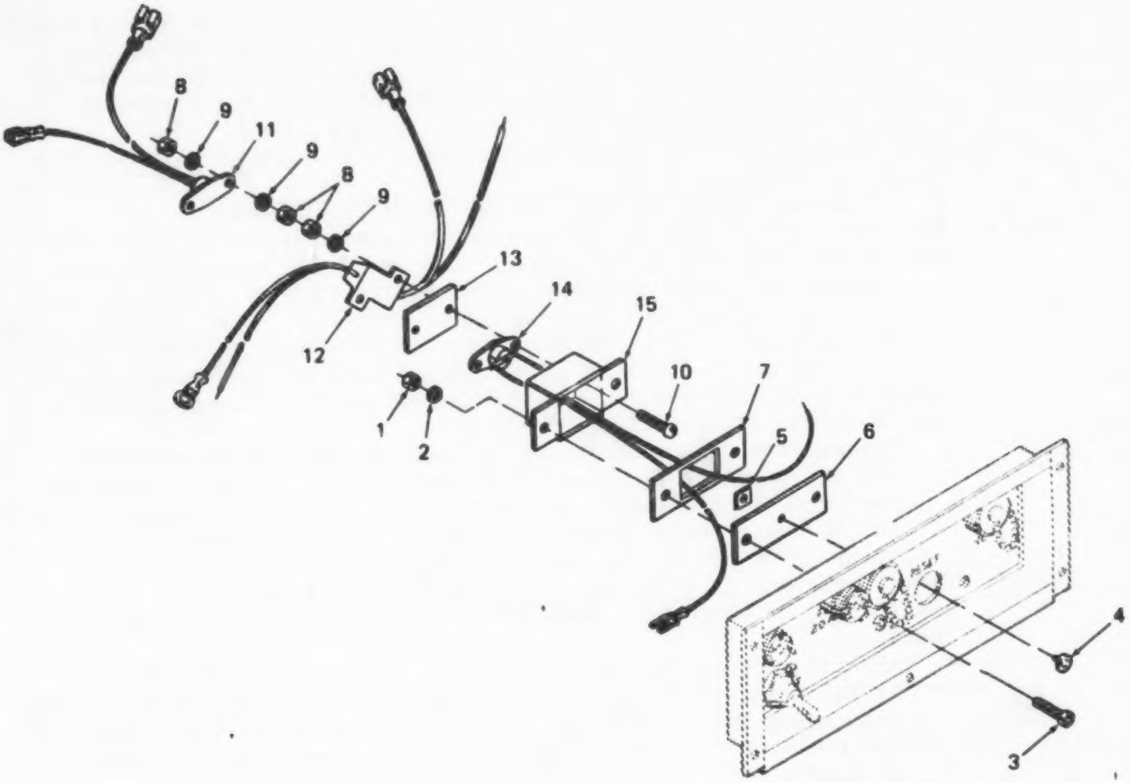
Step 1. Remove top and side cover panels, and pull out control panel. With power connected, turn on the heater and check that the timer assemb heats.

Replace the timer assembly if it fails to become noticeably war within 45 to 70 seconds. To remove timer assembly, tag and unsolder all leads. Remove two nuts (1, fig. 5-1), lock washers (2), and screws (3), and separate the timer assembly from the control panel.

NOTE

If replacement of timer assembly components is necessary, only disassemble to the level of replacement.

Remove reset button (4), and retainer (5) from outer seal (6), and remove inner seal (7). Remove two nuts (8) and lock washer (9), and remove delay thermostat (11). Remove four lock washer (9), and four nuts (8), and remove resistor (12) and shim (13). Reset thermostat (14) and screws (10) are potted inside the ti box (15) with Dow-Corning 732 RTV Silastic. Scrape the pottin compound from the timer box to gain access to the thermostat an screws. Remove the thermostat by bending the terminal tabs an pulling the thermostat through the hole in the timer box.
Install the components of the timer assembly in the reverse or of the index numbers in figure 5-1. Install the reset thermost (14) into the timer box (15) by bending the thermostat terminal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TS 4520-242-13/5-1

1. Nut
2. Lock washer
3. Screw
4. Reset button
5. Retainer
6. Outer seal
7. Inner seal
8. Nut
9. Lock washer
10. Screw
11. Delay thermostat
12. Resistor
13. Shim
14. Reset thermostat
15. Timer box

Figure 5-1. Timer components, exploded view.

Table 5-1. Direct Support Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

1 - Continued

tabs out and placing the thermostat through the hole in the ti box. After positioning the thermostat, bend the terminal tabs back to their normal position. After assembly, fill the insid of the timer box up to the level of the thermostat terminals with Dow-Corning 732 RTV Silastic, or equivalent.

Step 2. With power on, briefly jumper yellow and green leads on main termin block.

If blower begins to run, replace the timer assembly.

Step 3. Disconnect power plug and allow timer assembly to cool. Press RES button and check continuity between two red leads using an ohmmete

Replace the timer assembly if the switch is open after reset.

Step 4. Check control relay continuity using an ohmmeter. Test the resist of the relay coil. The resistance across terminals X1 and X2 (sho in fig. 5-2) must be 300 ±30 ohms. There must be continuity only tween terminals B2 and B3, and between A2 and A3, but no continuit across B1 and B2, or across A1 and A2.

Replace the control relay if it does not operate as specified. Tag and unsolder the electrical leads to the relay. Remove th two nuts, lock washers, and screws that secure the control rel to the heater case; remove the relay. Install a new control relay by reversing the removal procedure.

Step 5. Check motor resistor for continuity between green/white and grey leads using an ohmmeter. Continuity must be established across th leads.

Replace a defective motor resistor. Tag and unsolder the elec trical leads to the resistor. Remove the two nuts, lock washe and screws that secure the resistor to the heater case; remove the resistor. Install a new resistor by reversing the removal procedure.

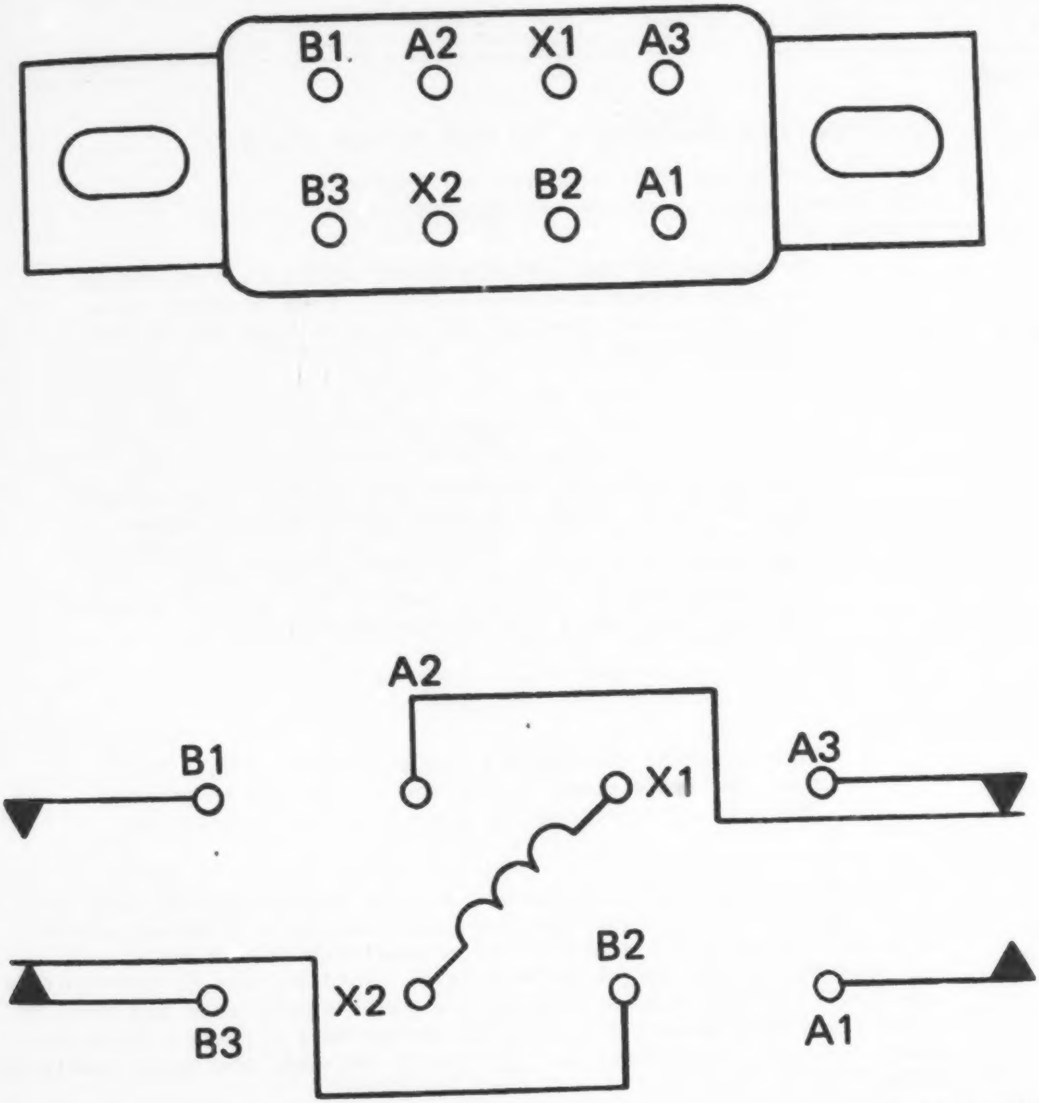
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Figure 5-2. Control relay terminal identification.

Table 5-1. Direct Support Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

1 - Continued

Step 6. Check ignition power supply for high voltage output.

WARNING

The output of the ignition power supply is high enough to cause severe electrical shock. When testing, take care to prevent physical contact with bare end of the ignition cable.

CAUTION

When checking spark, do not allow the spark gap to exceed 1/8 inch (3 mm). Greater gap will cause excessively high potential resulting in insulation breakdown either internally or in the ignition cable. Make sure there are no fuel and fumes in the area of grounded surface that could ignite when checking spark.

NOTE

When checking the ignition power supply, make sure that the input power is applied in the proper polarity. The unit will not operate when polarity is reversed.

Remove the top and left side panels to gain access to the ignitio
power supply. Connect the ignition power supply to a 28 vdc sour
of power. Connect the negative to an unpainted ground and connec
the positive to the yellow primary lead. Hold the end of the ign
cable near an unpainted portion of the power supply case and chec
a hot spark when power is applied to the primary circuit. If a h
spark does not jump across an 1/8-inch (3 mm) gap, the power supp
defective.

Replace a defective power supply.

Table 5-1. Direct Support Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1 - Continued

WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before repairing the heater.

Disconnect the power plug and remove the exhaust pipe connection. Disconnect the fuel line at the bulkhead fitting. Disconnect the ignition cable from the spark plug. Disconnect the yellow primary lead from the tab on the main terminal block, and the white/black lead from the burner head.

Remove the four screws (1, fig. 5-3) that secure the ignition case (61) to the bottom of the heater housing. Remove two screws (2) and lock washers (3) that secure the ignition case to the back of the heater case. Remove the ignition power supply from the heater case.

Separate the case top assembly from the case and coil assembly as follows: Remove two nuts (4), lock washers (5), and screws (6), and remove brace (7). Remove nut (8), lock washer (9), and screw (10), and separate the two white/black wires.

CAUTION

Do not separate case top from ignition case until interior wires are disconnected.

Pull the case top (44) away from the ignition case (61) to expose the interior wire connections. Remove two nuts (11), washers (12), and screws (13), and disconnect white/black wires (19) from power straps (54). Separate the case top (44) from the ignition case (61).

If transistors (21) must be replaced, remove screws (20), and remove the transistor, insulator (22), and socket (23) from case top (44).

Suppression capacitor (28), nut (26), lock washer (27), ferrite beads (29), connector (30), and choke (31) are potted inside case top (44) with Dow-Corning 732 RTV Silastic. Scrape the potting compound from the case top to gain access to the potted components.

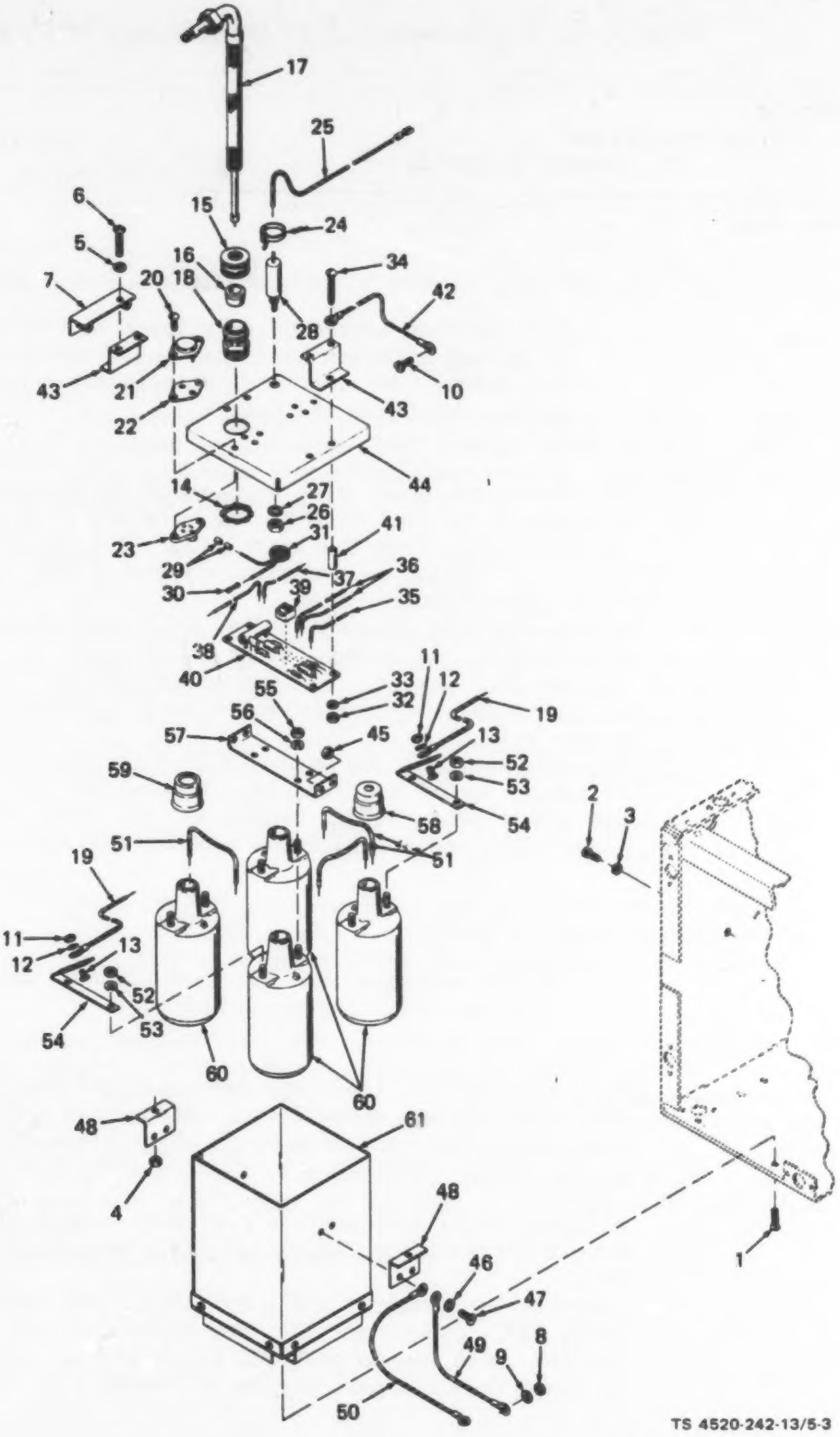
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Figure 5-3. Ignition power supply, exploded view.

Legend for figure 5-3:

1. Screw
2. Screw
3. Lock washer
4. Nut
5. Lock washer
6. Screw
7. Ignition brace
8. Nut
9. Lock washer
10. Screw
11. Nut
12. Lock washer
13. Screw
14. Nut
15. Compression nut
16. Compression sleeve
17. Ignition cable
18. Adapter
19. Wire
20. Screw
21. Transistor
22. Insulator
23. Socket
24. Cable tie
25. Wire
26. Nut
27. Lock washer
28. Suppression capacitor
29. Ferrite beads
30. Connector
31. Choke
32. Nut
33. Lock washer
34. Screw
35. Wire
36. Wire
37. Wire
38. Wire
39. Timer
40. PC board
41. Spacer
42. Wire
43. Upper bracket
44. Case top
45. Nut
46. Lock washer
47. Screw
48. Lower bracket
49. Wire
50. Wire
51. Wire
52. Nut
53. Lock washer
54. Power strap
55. Nut
56. Lock washer
57. Ground strap
58. Nipple
59. Ignition wire nipple
60. Ignition coil
61. Ignition case

Table 5-1. Direct Support Troubleshooting - Co

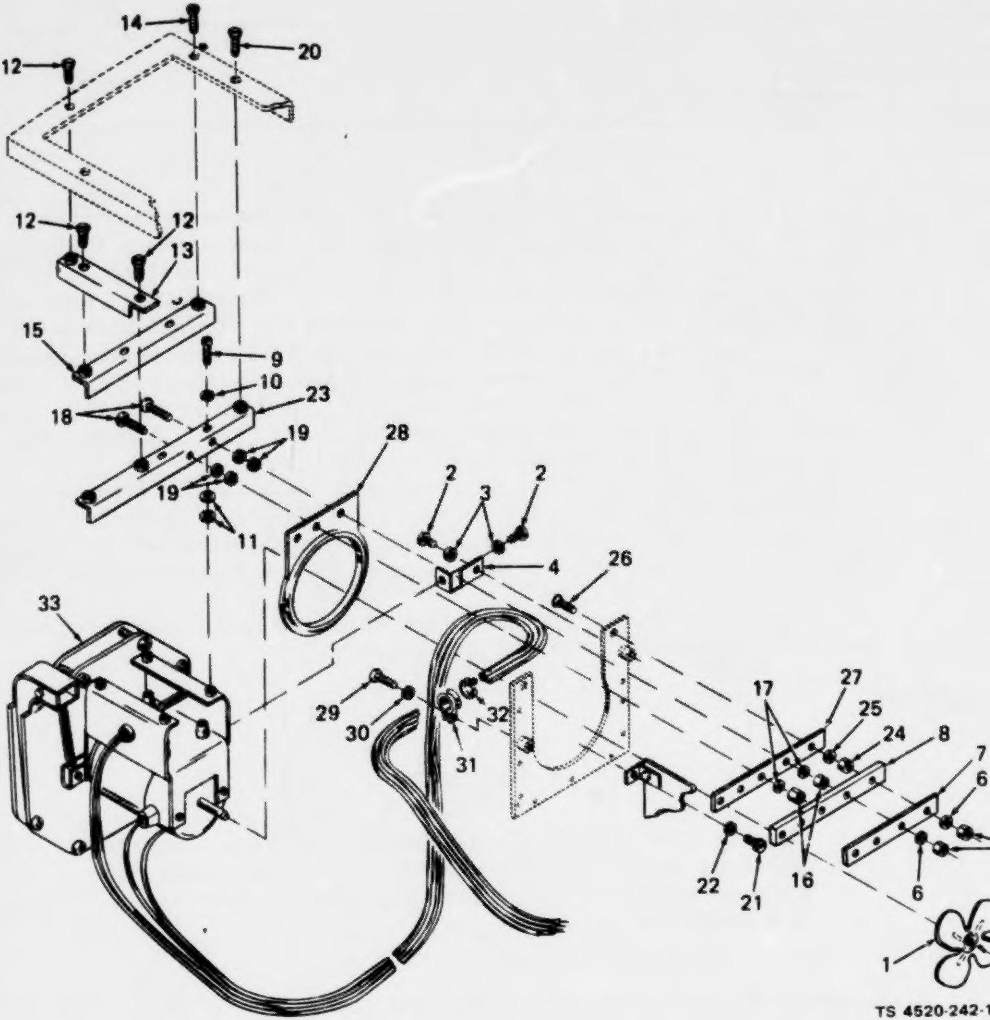
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1 - Continued

Unsolder lead wires from suppression capac
and connector (30). Remove nut (26), and
remove suppression capacitor (28).
If PC board (40) requires removal, tag and
Remove four nuts (32), and lock washers (3
board.
If timer (39) must be replaced, remove the
The timer has an eight-pin connection to th
socket connections from PC board and remove
If the case and coil assembly requires disa
straps (54) by removing nuts (52) and lock
ground strap (57) from ignition case (61) b
(45), lock washers (46), and screws (47).
from the coils (60) by removing four nuts (
(56).
Reassemble ignition power supply in the rev
assembly procedure, and recheck the high vo
Install the ignition power supply in the he
screws (2) and lock washers (3) through the
and into the ignition power supply. Instal
the bottom of the heater case and into the
power supply. Connect the high voltage ign
plug on the burner head. Connect the yellow
terminal board to which the other yellow le
Install the top and left side covers and in
into the POWER receptacle. Connect fuel li
the heater and check for proper operation.

2. HEATER IGNITES BUT BLOWER FAILS TO RUN.

Step 1. Remove the top, both side cover panels, and hea
Turn power on, wait for time delay, and check f
terminals using a multimeter set to read dc vol
Replace control relay if there is no power
Tag and unsolder the electrical leads to the
move the two nuts, lock washers, and screws
trol relay to the heater case; remove the co
Step 2. Disconnect motor leads and


14
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19
28
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3
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33
29
30
32
31
17
27
25
24
8
7
6
22
21
16
6
1

TS 4520-242-1

1. Axial fan
2. Screw
3. Lock washer
4. Stabilizer
5. Nut
6. Lock washer

12. Screw
13. Support bridge
14. Screw
15. Back support bracket
16. Nut
17. Lock washer

23. Center support stiff
24. Nut
25. Lock washer
26. Screw
27. Tie bar
28. Fan shroud
29. Screw

Table 5-1. Direct Support Troubleshooting - (

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

---

2 - Continued

Remove five nuts (5), lock washers (6), a
(7) and seal (8). Remove four screws (9
flat washers (11), three screws (12), an
Remove screw (14) and remove back suppor
two nuts (16), lock washers (17), screws
(19), screw (20), screw (21), lock washe
stiffener (23). Remove three nuts (24),
(26), tie bar (27), and fan shroud (28).
washer (30), cable clamp (31), and cable
and motor (33) from heater case.
Remove two screws (1, fig. 5-5) and lock
(24). Remove two nuts (3), lock washers
the motor studs. Separate motor and blo
two nuts (6), lock washers (7), screws (
(13).
Replace blower motor (24) and reassemble
port in the reverse order of disassembly

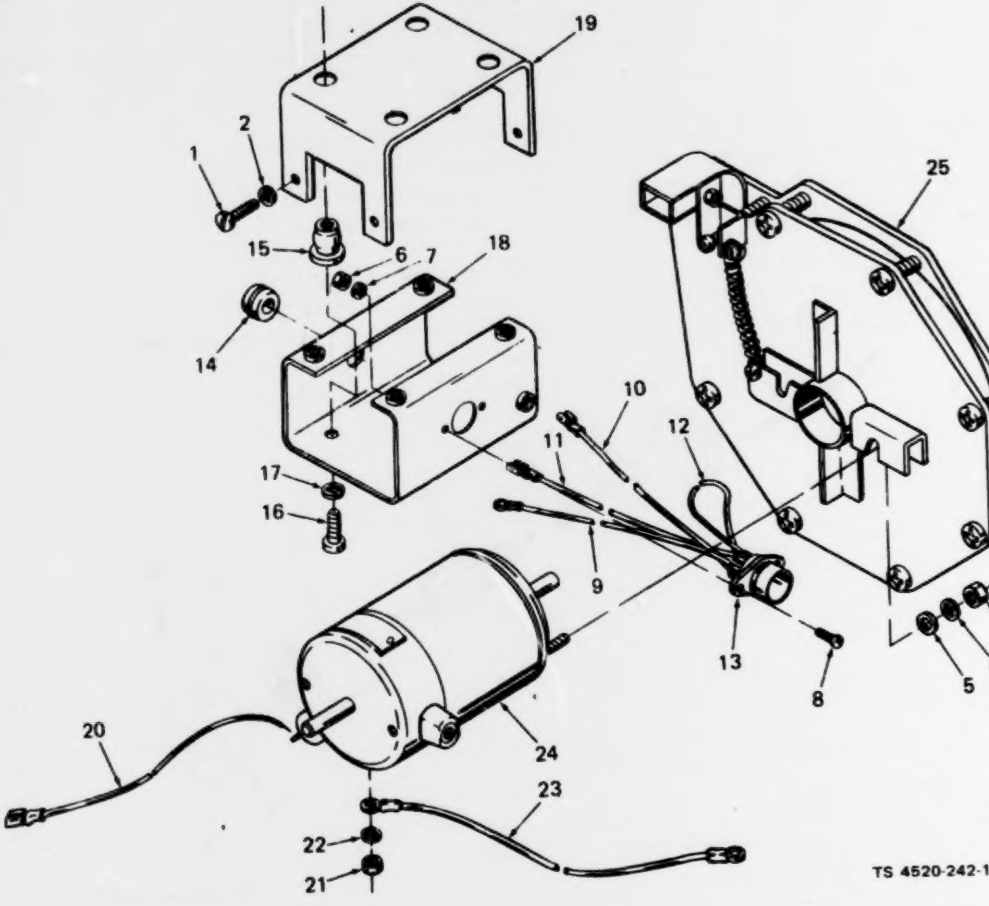
3. HEATER OVERHEATS.

WARNING

The ignition system of this heater
voltages which can cause severe ele
sure to disconnect the power plug b
the heater.

Step 1. Disconnect the power plug and remove top cov
axial fan is tight on the motor shaft, and n
Check for restricted fan. Tighten the f
on the hub of the fan.

Step 2. Connect power plug, start heater, and observ
cover panels removed.
Repair motor if motor runs slowly or vib
bearings, or if the motor protector ther
If the suppression capacitor (14, fig. 5
disassemble the motor and replace defect


19
2
1
25
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6
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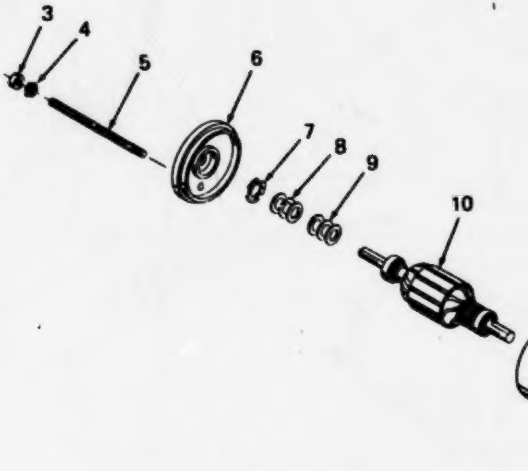
18
14
10
12
11
17
16
9
13
8
5
20
24
23
22
21

TS 4520-242-1

1. Screw
2. Lock washer
3. Nut
4. Lock washer
5. Flat washer
6. Nut
7. Lock washer
8. Screw

10. Wire
11. Wire
12. Wire
13. Tube socket
14. Grommet
15. Well nut
16. Screw
17. Lock washer

19. Lower support
20. Wire
21. Nut
22. Lock washer
23. Wire
24. Motor
25. Blower housing



1. Brush cap
2. Brush and spring
3. Nut
4. Lock washer
5. Stud
6. End bell
7. Spring washer

9.
10.
11.
12.
13.
14.
15.

Table 5-1. Direct Support Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3 - Continued

Separate the stator from commutator end bell (13) to
access to the capacitor mounting hardware. Unsolder
cal lead from the capacitor terminal inside the moto
(15) and lock washer (16), and remove capacitor (14)
bell.
Replace defective parts and reassemble the motor by
disassembly procedure. Test motor for proper operat

Section III. GENERAL MAINTENANC

5-6. ELECTRICAL COMPONENTS.

WARNING

This space heater contains dangerous voltages whic
electrical shock. Be sure to disconnect the power
ing the heater.

a. Disconnect the power plug. Remove the side and to

b. Clean all electrical components by wiping with a cl

c. Inspect all wires for cracks or broken insulation.

d. Inspect all receptacles and cables for bent or dam
or corroded sockets.

e. Inspect all wires and electrical components for co

f. Inspect all terminals for damage or corrosion and
minals.

g. Check all grounding leads and grounding straps.

5-7. MECHANICAL COMPONENTS.

WARNING

Clean parts in a well-ventilated area. Avoid inha
fumes and prolonged exposure of skin to cleaning s
posed skin thoroughly. Dry cleaning solvent (fed.
to clean parts is potentially dangerous to personn
Do not use near open flame or excessive heat. Fla
is 100°F (38°C).

a. Clean all mechanical components with a cloth dampe
(fed. spec. P-D-680). Wipe thoroughly and allow to dry.

b. Inspect all painted surfaces and touch up where ne

b. Inspect all threaded parts for broken or damaged threads and repla

c. Inspect bright metal hardware for integrity of plating, and replac
roded parts.

d. The data plates are riveted to the heater case. The rivets must b
out and replaced to install new data plates.

5-9. WIRING.

WARNING

This space heater contains dangerous voltages which can cause sev
electrical shock. Be sure to disconnect the power plug before re
ing the heater.

a. Removal.

(1) Remove the hardware which mounts the power and thermostat re
the control panel.

(2) Remove all wires from their connection points at the termina
flame switch, and other components. Tag the wires to aid in replacemen

b. Installation. Install in reverse order of removal. Consult wir

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASS

5-10. CONTROL PANEL.

a. Removal.

(1) Detach the control panel from the heater case by removing
removing the control panel to the extent of the attached wires.

(2) The individual components of the control panel can be read
this point.

b. Installation. Install in reverse order of removal.

CHAPTER 6

REPAIR OF CONTROL PANEL

6-1. DESCRIPTION. The following control panel components help control
tion:

a. Time Delay Assembly. The time delay assembly consists of the ti
(fig. 6-1), RESET thermostat S1, and the time delay thermostat S2.

(1) The timer heater is energized when the ON-OFF switch S3 is
It heats both the time delay thermostat and the RESET thermostat.

(2) The time delay thermostat S2 is normally open, until heat f
heater TH2 closes it. The time required for the timer heater to trip t
thermostat is longer than the time required by the glow plug to preheat
head to ensure rapid fuel ignition.

(3) When the time delay thermostat finally closes from the heat
heater TH2, it energizes the fuel pump FP1, air compressor M2, fuel flo
head, and the blower motor.

(4) If ignition proceeds normally, the contacts of the safety t
close, energizing relay R1. This disconnects the timer heater, allowin
down, and bypasses the time delay switch.

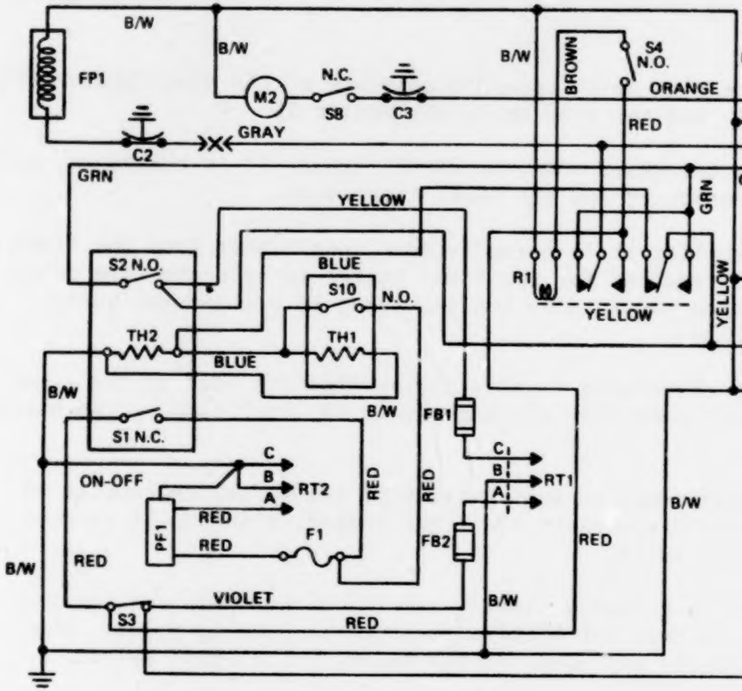
(5) The RESET switch S1 is normally closed. If the burner does
the timer heater will continue to heat the RESET switch to its opening
the RESET switch opens, it shuts off all power to the heater. The RESE
requires manual reset.

b. Receptacles. The THERMO and POWER receptacles are mounted on th
to provide connections to the room thermostat and to the 28 vdc power s
ate the heater.

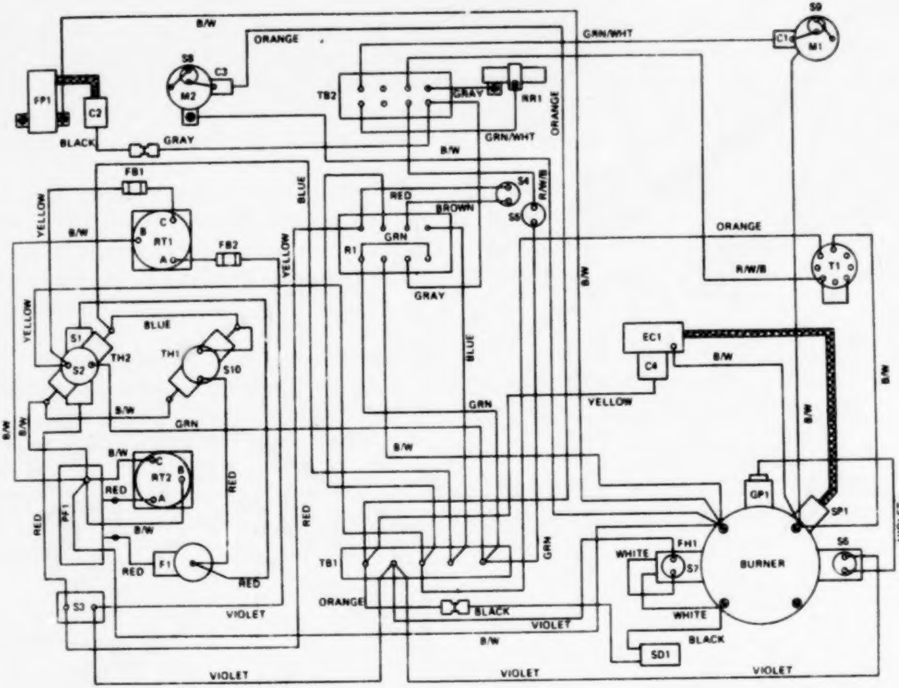
6-2. REMOVAL AND DISASSEMBLY.

WARNING

The ignition system of this space heater contains dangerous volt
which can cause severe electrical shock. Be sure to disconnect
power plug before repairing the heater.


B/W
FP1
B/W
M2
N.C.
S8
C3
B/W
BROWN
S4
N.O.
ORANGE
RED
C2
GRAY
GRN
GRN
YELLOW
S2 N.O.
BLUE
S10
N.O.
R1
YELLOW
YELLOW
TH2
TH1
BLUE
B/W
B/W
S1 N.C.
FB1
C
B
A
ON-OFF
RT2
C1
B
A
RT1
PF1
RED
RED
F1
RED
RED
FB2
RED
B/W
B/W
RED
VIOLET
S3
RED
B/W

KEY TO DIAGRAM			
C1	Capacitor-Vent. & Comb. Motor	S4	S
C2	Capacitor-Fuel Pump	S5	S
C3	Capacitor-Compressor	S6	S
C4	Capacitor-Ignition Coil	S7	S
F1	Fuse	S8 & S9	S
FH1	Fuel Heater	S10	S
FP1	Fuel Pump	SD1	S
EC1	Ignition Coil	SP1	S
GP1	Glow Plug	T1	T
M1	Vent. & Comb. Motor	TB1 & TB2	T
M2	Compressor	TH1 & TH2	T
R1	Relay-DPDT	R/W/B	F
RR1	Resistor	R/W	F


B/W
ORANGE
GRN/WHT
S9
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C2
TB2
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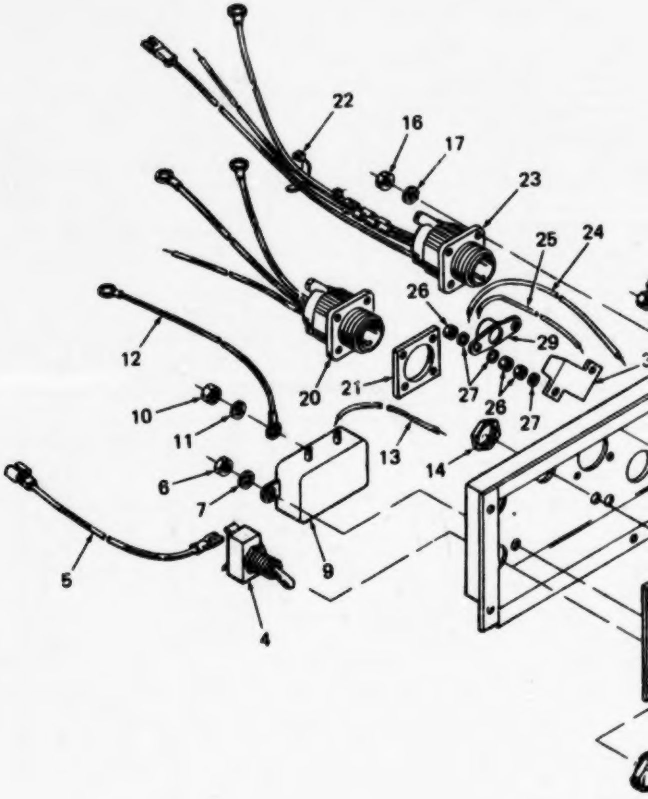
RR1
ORANGE
BLACK
GRAY
GRN/WHT
B/W
FB1
YELLOW
B/W
C
B
RT1
A
FB2
BLUE
YELLOW
RED
BROWN
S4
R/W/B
S5
GRN
R1
GRAY
ORANGE
T1
R/W/B
B/W
YELLOW
BLUE
S1
S2
TH2
TH1
S10
BLUE
EC1
C4
B/W
YELLOW
GRN
B/W
B/W
B/W
B/W
GRN
B/W
B/W
C
RT2
B
A
RED
RED
RED
FE1
B/W
RED
F1
RED
RED
TB1
GRN
GP1
SP1
FH1
WHITE
S7
BURNER
S6
S3
VIOLET
ORANGE
BLACK
VIOLET
B/W
WHITE
BLACK
SD1
VIOLET
VIOLET
VIOLET

KEY TO DIAGRAM

C1	Capacitor-Vent. & Comb. Motor	S4	Sw. Safety Thermostat
C2	Capacitor-Fuel Pump	S5	Sw. Overheat Thermostat
C3	Capacitor-Compressor	S6	Sw. Glow Plug Thermostat
C4	Capacitor-Ignition Coil	S7	Sw. Fuel Heater Thermostat
F1	Fuse	S8 & S9	Sw. Overheat Protector
FH1	Fuel Heater	S10	Sw. Maintenance Thermostat
FP1	Fuel Pump	SD1	Solenoid
EC1	Ignition Coil	SP1	Spark Plug
GP1	Glow Plug	T1	Timer
M1	Vent. & Comb. Motor	TB1 & TB2	Terminal Block
M2	Compressor	TH1 & TH2	Timer Heater
R1	Relay-DPDT	R/W/B	Red, White, Blue
RR1	Resistor	B/W	Black, White
RT1	Receptacle-Thermostat	GRN	Green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9
5
4

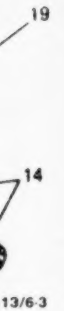
1. Screw
2. Lock washer
3. Boot
4. Switch
5. Wire
6. Nut
7. Lock washer
8. Screw
9. Filter
10. Nut
11. Lock washer
12. Wire
13. Wire
14. Fuse holde
15. Fuse
16. Nut
17. Lock washe
18. Screw
19. Cap
20. Receptacl
21. Insulator
22. Cable tie
23. Receptacl
24. Wire

d. If filter (9, fig. 6-3) must be replaced, tag and un the filter. Remove the five black and white wires by remov washer (11). Remove nut (6), lock washer (7), and screw (8 the control panel, and remove the filter.

e. Push in the cap on fuse holder (14) and rotate the c remove it from the fuse holder. Remove fuse (15) from the solder the three red wires from the fuse holder. Remove th the fuse holder from the front of the control panel. Remov the same way, except the spare fuse holder has no connected

f. To remove receptacles (20 and 23), remove nuts (16), screws (18), and remove the receptacles and insulators (21) Unscrew the retainer from the rear of the receptacle and pu access to the lead-to-pin connections. Unsolder the pins f the receptacles.

g. If maintenance thermostat (29) or resistor (30) must solder all leads. Remove two nuts (26), and lock washers (29). Remove four lock washers (27), four nuts (26), and resistor (30) from control panel.



h. To remove timer assembly, tag and unsolder all lead 6-4), lock washers (2), and screws (3), and separate the t trol panel.

NOTE

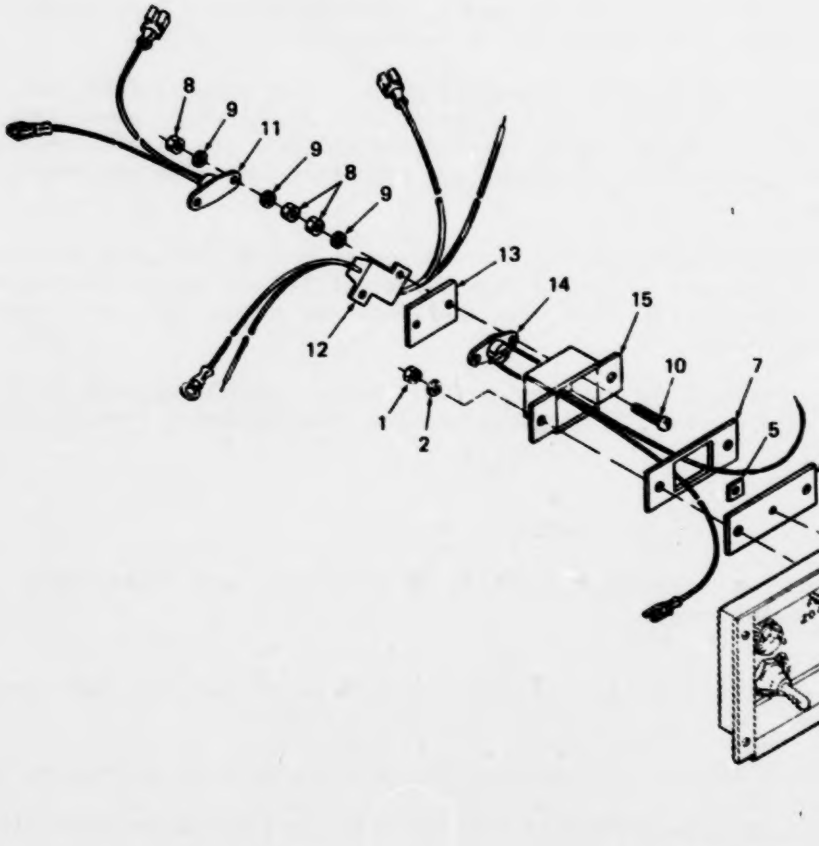
If replacement of timer assembly components is nece to the level of replacement.

(1) Remove reset button (4) and retainer (5) from inner seal (7). .

(2) Remove two nuts (8) and lock washers (9), and

(3) Remove four lock washers (9) and four nuts (8) and shim (13).

(4) Reset thermostat (14) and screws (10) are pott with Dow-Corning 732 RTV Silastic. Scrape the potting com gain access to the thermostat and screws. Remove the ther minal tabs and pulling the thermostat through the hole in


8
9
11
9
8
9
13
14
12
15
10
7
1
2
5

1. Nut
2. Lock washer
3. Screw
4. Reset button
5. Retainer
6. Outer seal
7. Inner seal

9. Lock washer
10. Screw
11. Delay thermo
12. Resistor
13. Shim
14. Reset thermo
15. Timer box

3. CLEANING AND INSPECTION.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (38°C).

a. Clean parts with a dry soft-bristle brush. Remove greasy or gummy dep
ith a cloth dampened lightly in dry cleaning solvent (fed. spec. P-D-680).

b. Inspect leads and components for worn or broken insulation, signs of o
eating, and other defects. Replace defective parts.

c. Visually inspect the resistors, thermostats, and timer assembly. Repl
onents if any damage is evident. Use an ohmmeter to test the removed timer
ress the reset button; there must be continuity between the two red leads of
eset thermostat. Check continuity between the blue lead and the white/black
f the resistor (timer heater TH2); there must be continuity. The delay ther
loses on rise to 65° ±5°F (18.3° ±2.8°C) and opens at 38° ±5°F (3.33° ±2.8°
hecking continuity of the delay thermostat green and yellow leads, be certa
hermostat is at its closing temperature.

CAUTION

Do not immerse the thermostats in any liquid to make temperature rise or fall.

NOTE

If the timer assembly has not been removed from the control panel, th
yellow, blue, and green leads must be disconnected from the main term
block before the continuity test is performed. Also, disconnect the
jumper wires from the resistor (timer heater TH2) to resistor (timer heater TH1).

The maintenance thermostat closes at 40° ±5°F (4.44° ±2.8°C) and open
55° ±5°F (12.8° ±2.8°C). When checking continuity between the red an
blue leads be certain the thermostat is at its closing temperature.

d. Replace boot (3, fig. 6-2) if it will not form a tight s
OFF switch (4).

6-4. REASSEMBLY AND INSTALLATION.

a. Install the components on the control panel in the rever
numbers in figure 6-3.

b. When installing the THERMO and POWER receptacles (20 and
panel, slide the plug and retainer over the ends of the leads b
leads to the pins in the other segment of the receptacle. Make
will be correct when the key in the plug is inserted in the key
housing. Slide the plug into the housing to cover the soldered
by installing the retainer.

c. Use the wiring diagram (fig. 6-2) as a guide when instal
components.

d. Install the components of the timer assembly in the reve
numbers in figure 6-4. Install the reset thermostat (14) into
bending out the thermostat terminal tabs and placing the thermo
in the timer box. After positioning the thermostat, bend the t
their normal position. After assembly, pot the inside of the t
level of the thermostat terminals with Dow-Corning 732 RTV Sila
Install the control panel in the front of the heater case and s
(1, fig. 6-3) and lock washers (2). Reinstall the side cover p
power and thermostat plugs, and test heater for proper operatio

CHAPTER 7

REPAIR OF IGNITION POWER SUPPLY

-1. DESCRIPTION.

a. The ignition power supply is mounted in the bottom of the heater housi t converts 28 vdc input to the high voltage output necessary to provide a ho t the spark plug in the burner head. This spark is necessary to ignite fuel o start combustion. A shielded high voltage cable connects the secondary of ower supply to the spark plug.

b. The ignition power supply employs a solid state oscillating circuit wh apidly makes and breaks the primary circuits to the four parallel coils. Th luces high voltage in the secondary which induces the spark plug to make a sp ausing fuel ignition. All components of the power supply are mounted in the ion case except the suppression capacitor. The capacitor is mounted on the op cover.

7-2. REMOVAL.

WARNING

> The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before repairing the heater.

a. Disconnect the power plug and remove the top and left side panels to access to the ignition power supply. Remove the exhaust pipe.

b. Disconnect the fuel line at the bulkhead fitting.

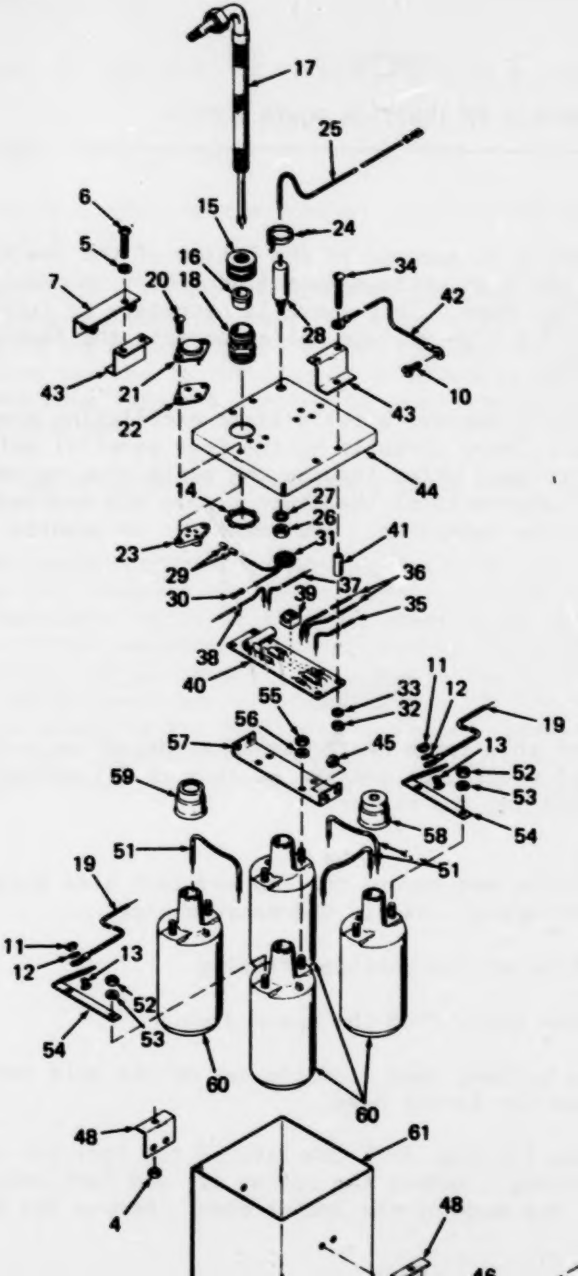
c. Disconnect the ignition cable from the spark plug.

d. Disconnect the yellow primary lead from the tab on the main terminal and the white/black lead from the burner head.

e. Remove the four screws (1, fig. 7-1) that secure the ignition case (the bottom of the heater housing. Remove two screws (2) and lock washers (secure the ignition case to the back of the heater case. Remove the igniti supply from the heater case.

f. Separate the case top assembly from the case and coil assembly.

(1) Remove the nuts (4), lock washers (5), and screws (6), and remo



Legend for 7-1:

1. Screw
2. Screw
3. Lock washer
4. Nut
5. Lock washer
6. Screw
7. Ignition brace
8. Nut
9. Lock washer
10. Screw
11. Nut
12. Lock washer
13. Screw
14. Nut
15. Compression nut
16. Compression sleeve
17. Ignition cable
18. Adapter
19. Wire
20. Screw
21. Transistor
22. Insulator
23. Socket
24. Cable tie
25. Wire
26. Nut
27. Lock washer
28. Suppression capacitor
29. Ferrite beads
30. Connector
31. Choke
32. Nut
33. Lock washer
34. Screw
35. Wire
36. Wire
37. Wire
38. Wire
39. Timer
40. PC board
41. Spacer
42. Wire
43. Upper bracket
44. Case top
45. Nut
46. Lock washer
47. Screw
48. Lower bracket
49. Wire
50. Wire
51. Wire
52. Nut
53. Lock washer
54. Power strap
55. Nut
56. Lock washer
57. Ground strap
58. Nipple
59. Ignition wire nipple
60. Ignition coi
61. Ignition cas

CAUTION

Do not separate case top from ignition case until i
disconnected.

(3) Pull the case top (44) away from the ignition
interior wire connections.

(4) Remove two nuts (11), washers (12), and screws
black wires (19) from power straps (54). Separate the cas
case (61).

NOTE

Do not replace the following parts unless they are
following the cleaning and inspection procedures de

g. If the transistors (21), must be replaced, remove s
transistor, insulator (22), and socket (23) from the case

h. Suppression capacitor (28), nut (26), lock washer (
connector (30), and choke (31) are potted inside the case
732 RTV Silastic. Scrape the potting compound from the to
potted components. Unsolder lead wires from suppression c
and connector (30). Remove nut (26), and lock washer (27)
capacitor (28).

i. If the PC board (40) requires removal, tag and unso
nuts (32), and lock washers (33), and remove the PC board.

j. If the timer (39) must be replaced, remove the time
timer has an eight-pin connection to the socket. Unsolder
board and remove socket.

k. If the case and coil assembly requires disassembly,
by removing nuts (52) and lock washers (53). Remove the
ignition case (61) by removing four nuts (45), lock washer
Remove the ground strap from the coils (60) by removing fo
(56).

7-3. CLEANING AND INSPECTION.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation c
fumes and prolonged exposure of skin to cleaning solvent. Was
skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) us
clean parts is potentially dangerous to personnel and property
use near open flame or excessive heat. Flash point of solvent
(38°C).

a. Wipe the exterior of the ignition power supply with a cloth da
dry cleaning solvent (fed. spec. P-D-680). Take care to prevent sol
ing the interior of the unit.

WARNING

The output of the ignition power supply is high enough to cau
electrical shock. When testing, take care to prevent physica
with bare end of the ignition cable.

CAUTION

When checking spark, do not allow the spark gap to exceed 1/8
(3 mm). Greater gap will cause excessively high potential re
in insulation breakdown either internally or in the ignition

NOTE

When checking the ignition power supply, make sure that the i
is applied in the proper polarity. The unit will not operate
polarity is reversed.

b. To check the operation of the ignition power supply, connect
source of power. Connect the negative to an unpainted ground and co
to the yellow primary lead. Hold the end of the ignition cable near
tion of the power supply case and check for a hot spark when power i
primary circuit. If a hot spark does not jump across an 1/8-inch (3

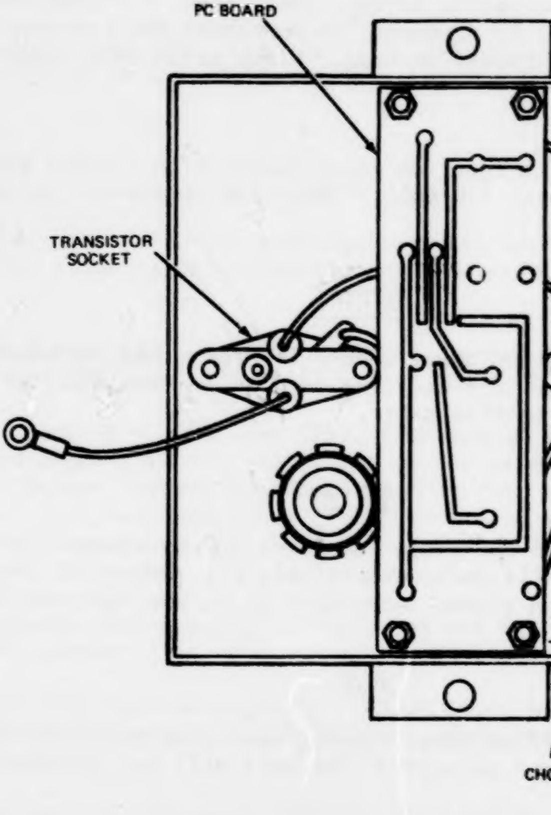

PC BOARD
TRANSISTOR SOCKET

Figure 7-2. Ignition case top,

(1) Replace timer (39, fig. 7-1). Recheck per step b above.

(2) Replace transistors (21). Recheck per step b above.

(3) Check for continuity from yellow power lead to connection
If no continuity, replace PC board (40) and recheck per step b above.

(4) Replace coils (60). Recheck per step b above.

(5) Replace ignition power supply. Recheck per step b above.

(6) Secure the case top (44, fig. 7-1) to the ignition power
nuts (4), lock washers (5), screws (6), and brace (7).

7-4. INSTALLATION.

a. Position the ignition power supply in the heater case. Instal
and lock washers (3) through the back of the heater case and into the
supply. Install four screws (1) through the bottom of the heater cas
bottom of the ignition power supply.

b. Connect the high voltage ignition cable to the spark plug on t

c. Connect the yellow lead to the tab on the terminal board to wh
yellow leads are connected.

d. Install the top and left side covers and insert the power plug
receptacle. Connect fuel line and exhaust. Start the heater and che
operation.

CHAPTER 8

REPAIR OF ELECTRICAL CONTROL COMPONENTS

8-1. DESCRIPTION.

a. The electrical components which control automatic heater operat
are not mounted on the control panel, include the control relay R1, fl
thermostat S4, timer T1 (delay relay) and overheat thermostat S5. Two
TB1 and TB2 are provided to facilitate making electrical connections.
mounted components are, motor resistor RR1, fuel heater FH1, fuel heat
S7, and glow plug thermostat S6.

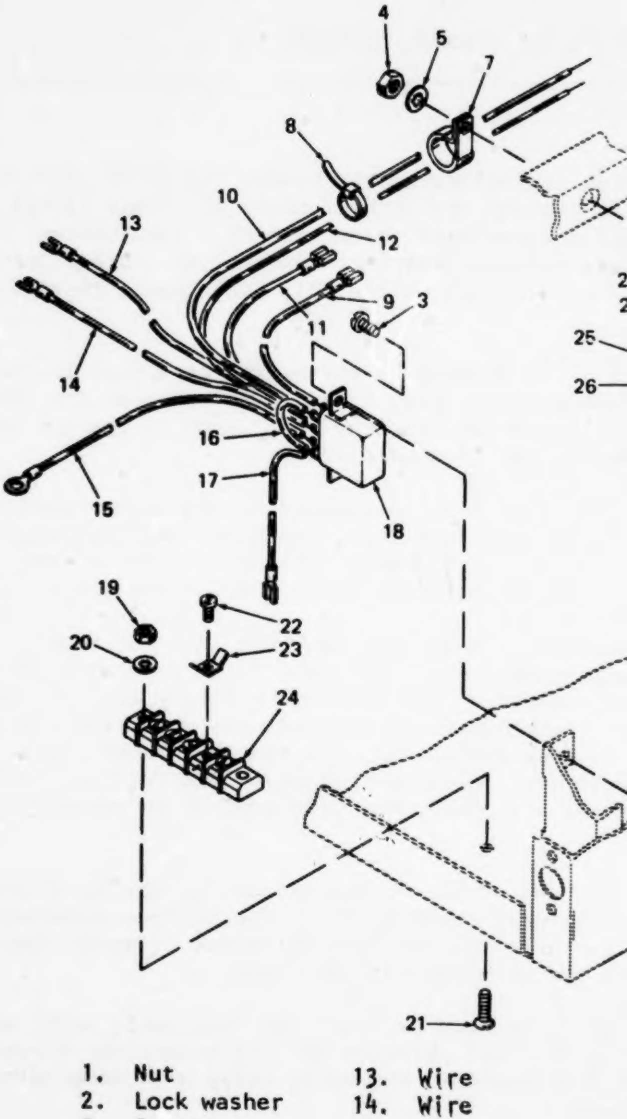
b. The control relay (18, fig. 8-1) is mounted on the heater case
control panel. This double-pole, double-throw relay is energized thro
safety thermostat S4 to switch heater operation from the start mode to
when the presence of heat is detected by the thermostat S4.

c. The flame safety thermostat (15, fig. 8-2) is mounted in the he
the heat exchanger. When the fuel is ignited, the flame heats the hea
The flame safety thermostat heated by the heat exchanger allows curren
the control relay to change heater operation from the start mode to ru

d. The overheat thermostat is mounted on a bracket near the heat e
thermostat is normally closed. At a temperature of 250° ±6°F (118° to
thermostat opens. The thermostat is connected into the fuel solenoid
sor circuit so that when an excessive temperature is reached, the fuel
and air compressor will deenergize to stop combustion. As the thermos
210° ±12°F (92° to 105°C), the circuit will again be energized, the fu
will again open the fuel valve, and the air compressor will operate to
combustion.

e. Two terminal blocks (24 and 30, fig. 8-1) are mounted on the bo
heater housing to help facilitate electrical connections to the variou
of the heater. Connector tabs are installed on the terminal block to
multiple slip-on type connections to the terminals of the block.

f. The delay relay (28, fig. 8-2) is mounted on the blower and mot
bracket. The relay is connected into the fuel solenoid and air compre
When ignition does not occur within five seconds, the delay relay wil
fuel solenoid valve and air compressor.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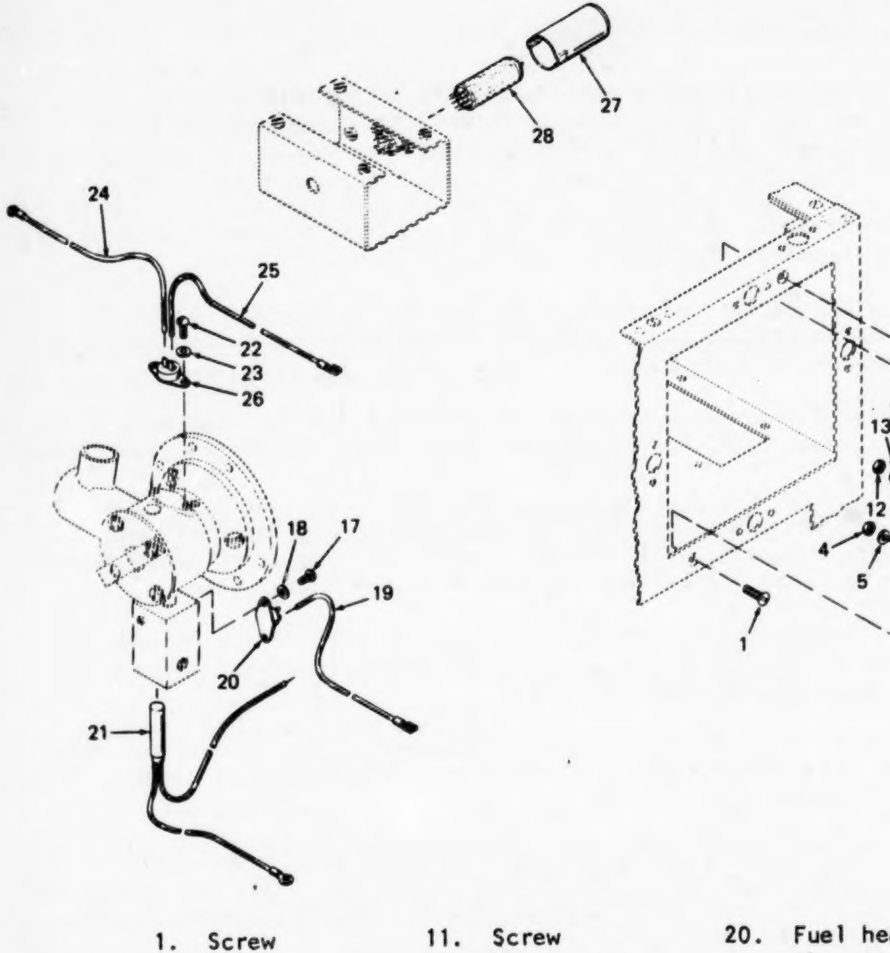
1. Nut
2. Lock washer
3. Screw
4. Nut
5. Lock washer
6. Screw

13. Wire
14. Wire
15. Wire
16. Jumper wire
17. Wire
18. Control relay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1. Screw
2. Wire
3. Wire
4. Nut
5. Lock washer
6. Screw
7. Overheat thermostat
8. Bracket
9. Nut

11. Screw
12. Nut
13. Lock washer
14. Screw
15. Flame safety thermostat
16. Bracket
17. Screw
18. Lock washer
19. Wire

20. Fuel hea thermos
21. Fuel hea
22. Screw
23. Lock wa
24. Wire
25. Wire
26. Glow pl thermos
27. Tube sh

8-2. REMOVAL.

WARNING

> The ignition system of this space heater contains dangero
> which can cause severe electrical shock. Be sure to disc
> power plug before servicing or repairing the heater.

a. Disconnect the power plug and remove the top and side co
access to the electrical control components. Remove the warm a

b. Tag and unsolder the electrical leads to the control rel
move two nuts (1), lock washers (2), and screws (3) that secure
the heater case; remove the control relay.

c. Tag and unsolder the electrical lead to resistor (36).
lock washers (32), and screws (33) that secure the resistor to
the resistor.

d. Tag and disconnect the electrical leads from the termina
and from tabs (23 and 29) on the terminal boards. Remove the n
screws, and remove the terminal blocks from the bottom of the h

e. Disconnect the leads from the overheat thermostat (7, fi
two nuts (4), lock washers (5), and screws (6), and remove the
from the bracket (8) on the heater case.

f. Disconnect the leads from the flame safety thermostat (1
(12), lock washers (13), and screws (14), and remove the flame
the bracket (16) on the heater case.

g. Disconnect wire (19) and unsolder the fuel heater (21) l
heater thermostat (20). Remove two screws (17) and lock washer
heater thermostat. Loosen the setscrew (20, fig. 10-1) in the
remove the fuel heater (21, fig. 8-2).

h. Disconnect the leads from glow plug thermostat (26). Re
and lock washers (23), and remove the glow plug thermostat.

i. Rotate the tube shield (27) counterclockwise and remove
Remove the delay relay (28) from its socket. The relay has a n
the socket.

-3. CLEANING AND INSPECTION.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100°F (28°C).

a. Wipe the components with a clean, dry cloth. Dampen the cloth with dr
ng solvent (fed. spec. P-D-680) if necessary to remove greasy or gummy depos
ot saturate the electrical components.

CAUTION

The control relay is designed for 28-volt operation only. Voltage in excess of 28 volts may destroy the relay coil (terminal X1 and X2).

NOTE

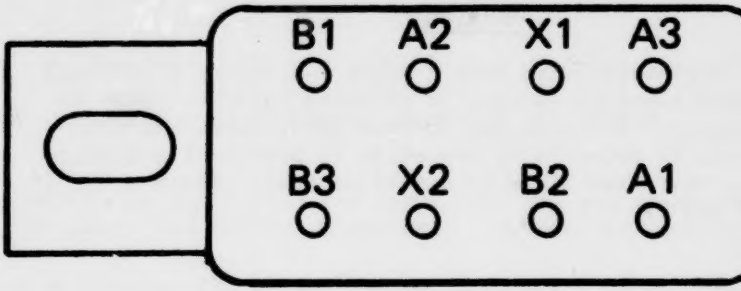
The control relay must be disconnected from the heater circuits befor
performing continuity tests. Alternate circuit paths within the heat
will confuse the test results.

b. Replace the control relay (18, fig. 8-1) if the case is damaged, or i
relay shows signs of overheating or arcing. Test the resistance of the rela
with an ohmmeter. The resistance across terminals X1 and X2 (shown in fig.
must be 300 ±30 ohms. There must be continuity only between terminals B2 an
and between A2 and A3, but no continuity across B1 and B2, or across A1 and
Replace the relay if it does not operate as specified.

c. To test the resistor, check for continuity between the green/white an
leads using an ohmmeter. Continuity must be established across these leads.
a defective resistor.

d. Inspect the terminal blocks for cracks, burned or damaged terminals,
sing terminal screws. Replace a damaged terminal block.

e. Inspect all wiring for loose or broken terminals, frayed or damaged i


B1
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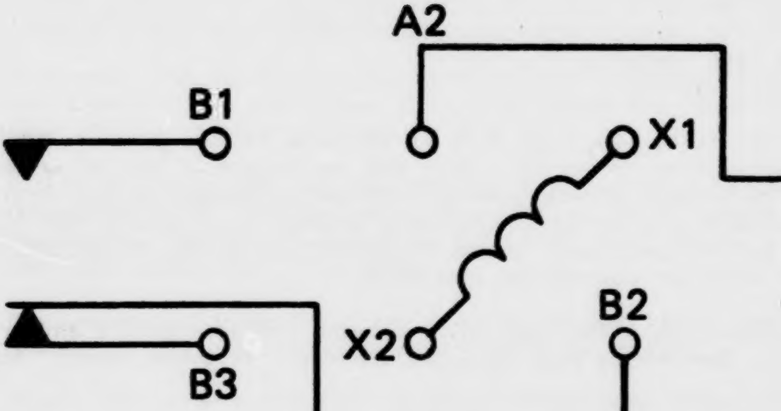
A3
B3
X2
B2
A1


A2
B1
X1
B2
X2
B3

ermostat if it is open below this temperature range, or if it is still close
ove 256°F (124°C). When cooling, the thermostat must reopen at 210° ±12°F
5°C). Replace a defective thermostat.

g. Inspect the flame safety thermostat for damaged terminals, broken insu
other damage. There must be continuity across the flame safety thermostat
inals at a temperature of 110° ±5°F (41° to 45°C). Replace the thermostat i
losed below this temperature range, or if it is still open above 115°F (45°C
oling, the thermostat must reopen at 90° ±5°F (30° to 34°C). Replace a def
ermostat.

h. Inspect the fuel heater thermostat for damaged terminal, broken insula
other damage. Test the fuel heater thermostat for continuity. The thermo
ntacts must be open (no continuity) at a temperature of 55° ±6°F (9.4° to 1
ntacts must be closed (continuity) at a temperature of 40° ±6°F (1.1° to 7.
lace the thermostat if it does not perform as described.

i. Inspect the glow plug thermostat for damaged terminals, broken insulat
ther damage. Test the glow plug thermostat for continuity. The thermostat
ust be open (no continuity) at a temperature of 55° ±6°F (9.4° to 16°C). Th
acts must be closed (continuity at a temperature of 40° ±6°F [1.1° to 7.8°C]
lace the thermostat if it does not perform as described.

j. Inspect the fuel heater for damaged terminal, broken insulation, or ot
amage. Test the fuel heater for proper operation. Connect the two heater
source of 28-volt dc power. Replace the heater if it does not heat.

k. Inspect the timer (delay relay) for cracks, bent pins, or other damage

-4. INSTALLATION.

a. Install the control relay, thermostat, timer, resistor, fuel heater, a
erminal blocks by reversing the removal and disassembly procedure. Refer to
-1 and 8-2.

b. After installation, install the side and top cover panels and insert
lug. Check the operation of the heater. Correct any defective operation.

CHAPTER 9

REPAIR OF BURNER

9-1. DESCRIPTION. The burner mounts on the end of the heat exchanger, mounting for the spark plug, glow plug, fuel heater, solenoid valve, an bowl. Combustion air supplied by the combustion air blower enters the passes into the burner head combustion chamber, where it mixes with the This mixture is ignited and burns within the burner head.

9-2. REMOVAL AND DISASSEMBLY.

WARNING

> The ignition system of this space heater contains dangerous volt which can cause severe electrical shock. Be sure to disconnect power plug before repairing the heater.

a. Disconnect the power and thermostat plugs. Disconnect the fuel move the top and side cover panels.

b. Disconnect the glow plug thermostat leads, fuel heater thermosta heater leads, fuel solenoid leads, and all ground leads attached to the plate mounting screws. Disconnect the fuel supply tube from the fuel f

c. Disconnect the compression nut (3, fig. 9-1) of the compressor t at the connector (6) in the compressor outlet.

d. Loosen the hose clamps (1) and remove combustion air tube (2) fr outlet and the burner head inlet.

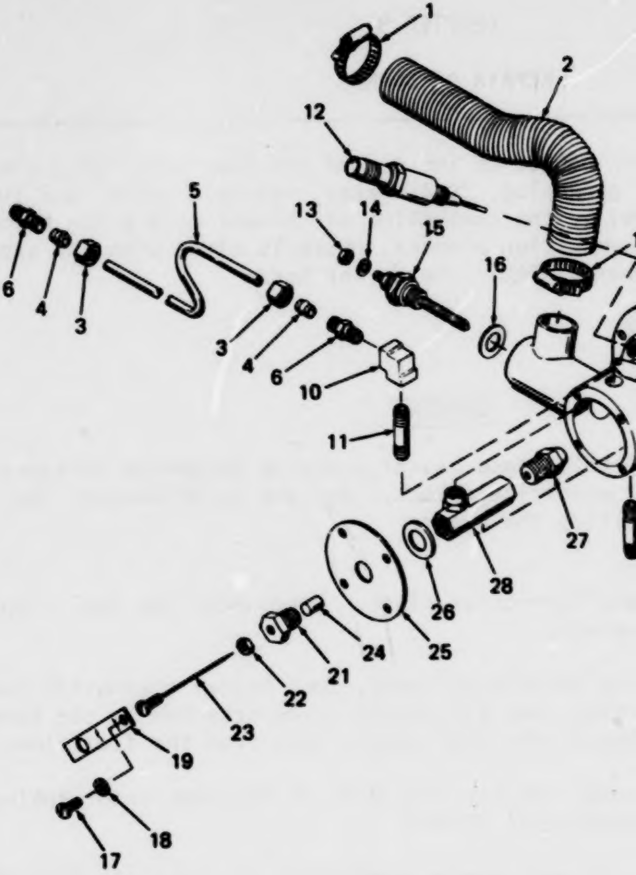
e. Unscrew the nut on the ignition cable and remove the cable. Uns plug (12) and remove the spark plug from the burner.

f. Remove the nut (13) and lock washer (14), and disconnect the pur glow plug (15). Unscrew and remove the glow plug and the gasket (16) f (32).

g. Remove the screws (7) and lock washers (8) securing the burner t exchanger housing. Remove the burner and burner choke (9).

h. Remove the vent tube from the burner. Disconnect pipe nipple (1 and fuel preheater.

i. Remove one screw (17) and lock washer (18) securing the needle to the burner. Remove the fuel adjustment needle assembly by unscrewi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1. Hose clamp
2. Air tube
3. Compression nut
4. Compression sleeve
5. Compressor tubing
6. Connector
7. Screw
8. Lock washer
9. Burner choke
10. Elbow
11. Pipe nipple
12. Spark plug
13. Nut
14. Lock washer
15. Glow plug
16. Glow plug gaske
17. Screw
18. Lock washer
19. Needle retainer
20. Setscrew
21. Pipe plug
22. Nut

Figure 9-1. Burner, expl

j. Remove elbow (10) and pipe nipple (11). Remove three screws (18), burner cover plate (25), and burner gasket (26). Remove nozz (28) by loosening two setscrews (20).

k. Remove four screws (29) and lock washers (30) securing burne burner (32).

9-3. CLEANING AND INSPECTION.

WARNING

> Clean parts in a well-ventilated area. Avoid inhalation of and prolonged exposure of skin to cleaning solvent. Wash ex thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used is potentially dangerous to personnel and property. Do not flame or excessive heat. Flash point of solvent is 100°F (

a. Clean all metal parts in dry cleaning solvent (fed. spec. P- wire brush to remove deposits from the burner. Do not immerse the vent. If necessary, use compressed air to dry the inside of the b stalling it in the heater.

b. Inspect the electrode and outer shell of the spark plug for Inspect ceramic parts for cracks or breaks. Inspect threads for d damaged spark plug.

c. Inspect the glow plug for cracks, frayed insulation, loose defective element winding, and other damage. Apply 28 vdc across t and check that the glow plug heats. Replace a damaged or defectiv

d. Inspect the fuel adjusting needle tip for wear, scoring, or place the fuel adjusting needle if the needle is bent or damaged.

e. Inspect the nozzle (27) needle seat for wear, scoring, or o the nozzle if damaged.

f. Inspect the burner head (31) perforations and blades for cr distortion. The burner head blades should be slightly bent away f of the burner head. Replace the burner head if damaged.

g. Inspect the burner for cracks, breaks, and distortion. Che in the spark plug, glow plug, vent tube, and screw thread holes ar place a damaged burner.

b. Assemble the nozzle (27) and nozzle adapter (28). the burner, align the two threaded holes for pipe nipples and nozzle adapter by tightening setscrews (20).

c. Reassemble fuel adjustment needle assembly by posi ment needle (23). Install this assembly into pipe plug (needle seal (24) over the needle. Turn the fuel adjustme (21) until the top of the needle head is 7/16 inch (11 mm plug. Maintain this dimension and tighten the nut (22). of the pipe plug (21) with Permatex No. 1, or equivalent, ment needle assembly through burner cover plate (25). In on pipe plug (21). Turn pipe plug (21) until the threads (28) threads. Use three screws (17) and lock washers (18 plate (25) to the burner.

d. Tighten pipe plug (21) until pipe plug head is flu Position needle retainer (19) over the slotted end of adj secure screw (17) and lock washer (18).

e. Coat the threads of pipe nipples (11) with Permate install into adapter nozzle (28) through the holes in bur

f. Install the burner choke (9) and burner. Secure w washers (8).

g. Use a new gasket (16) and install glow plug (15) i purple lead using lock washer (14) and nut (13).

h. Position the ignition cable and tighten the igniti

i. Slide the clamps (1) over the ends of the combusti tube over the combustion air blower and the burner air in

j. Install compressor tube, fuel lines, and electrica

k. Install the top and side cover panels. Connect th heater operation. Adjust the fuel adjustment needle if n operation.

l. Fuel Adjustment. When the type of fuel being burn or when the heater is subjected to extremely low ambient be necessary to readjust the fuel adjustment needle on th combustion.

NOTE

(1) If heater smokes, turn the fuel adjustment needle 1/8 tu
reduce the fuel flow. Observe heater operation for 1 minute. If sm
turn the needle an additional 1/8 turn and observe operation. Conti
tion is satisfactory.

(2) If heater operation is erratic, or heater fails to opera
extremely low ambient temperatures, turn the fuel adjustment needle
clockwise to increase fuel flow. Observe operation for 1 minute. C
the needle counterclockwise 1/8 turn until heater operation is satis
heater is burning smoothly, there should be little or no smoke from
let and the heat exchanger tubes should not be red in color.

CHAPTER 10

REPAIR OF FUEL SYSTEM

10-1. DESCRIPTION. The space heater fuel system consists of a fuel
pump, fuel float bowl, solenoid valve, and the interconnecting lines

a. Fuel Filter. The fuel filter traps and holds dirt, moisture,
taminants before they can enter the heater fuel system. The fuel fil
disc-type element contained in a removable sediment bowl.

b. Fuel Pump. A 28-volt, pulsating-type electric fuel pump draws
fuel supply and pumps it to the fuel float bowl. The pump also conta
remove any contaminants which may have passed through the fuel filter

c. Fuel Float Bowl. The fuel float bowl meters the flow of fuel
achieve efficient combustion. Sensitive adjustment of this flow is p
adjustment needle on the burner which enables you to manually adjust
according to the burning characteristics of the various fuels this he

d. Solenoid Valve. The solenoid valve controls the flow of fuel
float bowl to the fuel nozzle. This electrically controlled device o
valve when the thermostat calls for heat and closes the valve when th
ment is satisfied.

e. Fuel Lines. Fixed fuel lines carry the fuel from the fuel fil
pump. A flexible fuel tube carries the fuel from the fuel pump to th
bowl. A vent tube from the top of the fuel float bowl to the burner
to the burner head in the event of fuel float bowl malfunction. A fl
ries pressurized air from the compressor to the burner to atomize fue

10-2. FUEL FLOAT BOWL.

a. Removal.

WARNING

**The ignition system of this space heater contains dangerous vo
which can cause severe electrical shock. Be sure to disconnec
power plug before repairing the heater.**

(1) Disconnect the power plug and shut off the fuel supply.
and side cover panels for access to the fuel float bowl.

(2) Disconnect the glow plug thermostat leads, fuel heater t

(3) Remove the vent tube from the burner and flo nipple from the burner and fuel preheater. Remove the f and fuel preheater as an assembly.

(4) Remove pipe nipple (1, fig. 10-1) and remove

b. Disassembly.

(1) Remove four screws (4), lock washers (5), an

(2) Remove float pin (8), float (9), needle (10) gasket (12).

c. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inh and prolonged exposure of skin to cleaning solven thoroughly. Dry cleaning solvent (fed. spec. P-D is potentially dangerous to personnel and propert flame or excessive heat. Flash point of solvent

(1) Clean metal parts in dry cleaning solvent (f parts to dry thoroughly before reassembly.

(2) Inspect the needle tip and needle seat for w Replace damaged parts.

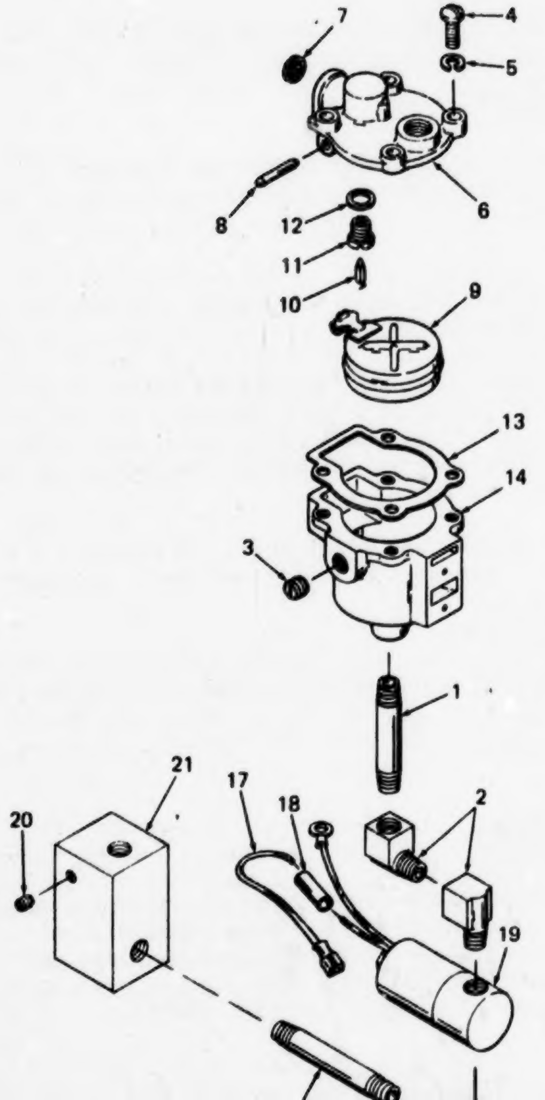
d. Reassembly and Installation.

(1) Install a new seat gasket (12) and assemble cover (6).

(2) Position needle (10) on float (9) and into n ition on float cover (6) with float pin (8).

(3) Use a new cover gasket (13) and assemble flo with four screws (4) and lock washers (5).

(4) Coat the threads of pipe nipple (1) with Per and install into fuel float bowl and elbow (2).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1. Pipe nipple
2. Elbow
3. Pipe plug
4. Screw
5. Lock washer
6. Float cover
7. Inlet screen
8. Float pin
9. Float
10. Needle
11. Needle seat
12. Seat gasket
13. Cover gasket
14. Bowl
15. Pipe nipple
16. Elbow
17. Wire
18. Connector
19. Solenoid valve

(7) Install the cover panels, power plug, and turn on fuel su
heater and check operation.

10-3. SOLENOID VALVE AND FUEL PREHEATER.

a. Removal.

WARNING

The ignition system of this space heater contains dangerous vo
which can cause severe electrical shock. Be sure to disconnec
power plug before repairing the heater.

(1) Disconnect the power plug and shut off the fuel supply.
and side cover panels for access to the solenoid valve.

(2) Disconnect the glow plug thermostat leads, fuel heater th
fuel heater leads, fuel solenoid leads, and all ground leads attache
Disconnect the fuel supply tube from the fuel float bowl. Disconnect
tube at the compressor. Remove the combustion air tube. Remove the
Remove the burner from the heat exchanger housing.

(3) Remove the vent tube from the burner and float bowl. Dis
nipple from the burner and fuel preheater. Remove the fuel float bo
valve, and fuel preheater as an assembly.

(4) Remove pipe nipple (1), two elbows (2), pipe nipple (15),
and solenoid valve (19). Loosen setscrew (20) and remove the heater
fuel preheater (21).

b. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of s
and prolonged exposure of skin to cleaning solvent. Wash exp
thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used t
is potentially dangerous to personnel and property. Do not u
flame or excessive heat. Flash point of solvent is 100°F (38

(4) Test the fuel heater for proper operation. Connect two heater lead
urce of 28-volt dc power. Replace the heater if it does not heat.

. Reassembly and Installation.

(1) Install the heater cartridge in the fuel preheater (21) and secure
crew (20). Install pipe nipple (15), elbow (16), solenoid valve, (19), and
ws (2). Install pipe nipple (1). Use Permatex No. 1, or equivalent, on pi
ads.

(2) Install the fuel float bowl, solenoid valve, and fuel preheater as
mbly on the burner using the pipe nipple to connect the assembly to the bu
all the vent tube on the float bowl and burner.

(3) Install the burner on the heat exchanger housing. Install the igni
e. Install the combustion air tube. Connect the compressor tube to the co
Connect the fuel supply tube to the fuel float bowl. Connect the glow p
mostat leads, fuel heater thermostat leads, fuel heater leads, fuel soleno
s, and all ground leads to the burner.

(4) Install the top and side cover panels. Connect the fuel supply an
r plug. Start the heater and check operation.

. FUEL PUMP.

. Removal.

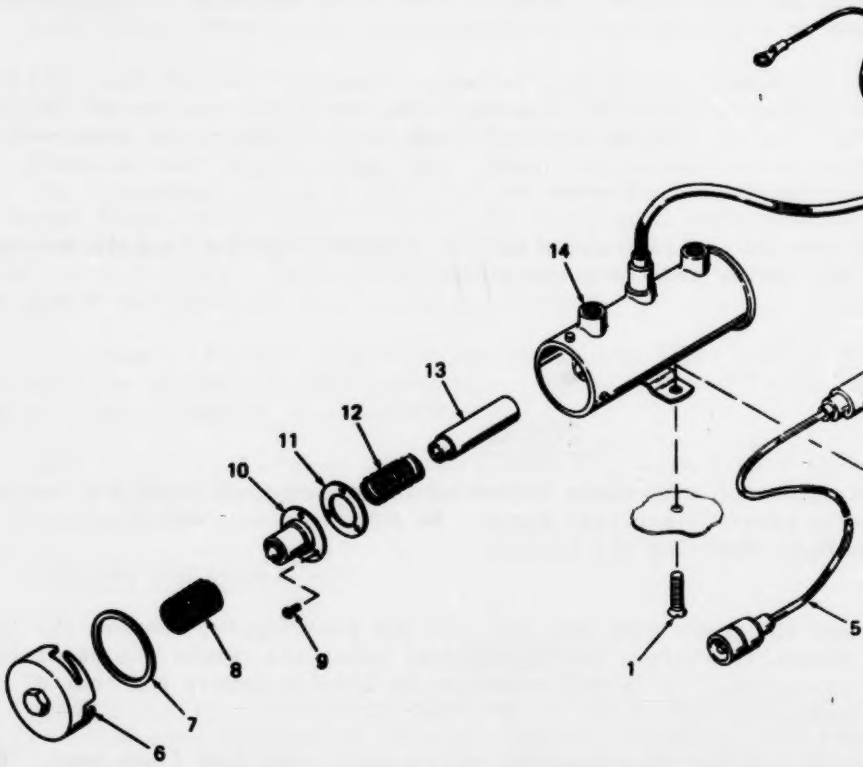
WARNING

The ignition system of this space heater contains dangerous voltages which can cause severe electrical shock. Be sure to disconnect the power plug before repairing the heater.

(1) Disconnect the power plug and shut off the fuel supply. Remove th
e cover panel. Remove the screws from the control panel and remove the pane
full extent of its wires. It is not necessary to totally remove the contr
remove the fuel pump.

(2) Disconnect the fuel tube from the fuel pump to the fuel float bowl
nect the fuel supply tube at the fuel filter. Remove the fuel filter, pipe
elbow.

(3) Disconnect cable (5, fig. 10-2). Remove nuts (2), lock washers (3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1. Screw
2. Nut
3. Lock washer
4. Wire
5. Cable
8. Filter screen
9. Screw
10. Spring cup
11. Cup gasket
12. Plunger sprin

c. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fu
and prolonged exposure of skin to cleaning solvent. Wash exposed skin
thoroughly. Dry cleaning solvent (fed. spec. P-D 680) used to clean p
is potentially dangerous to personnel and property. Do not use near o
flame or excessive heat. Flash point of solvent is 100°F (38°C).

(1) Clean the exterior of the fuel pump with a cloth dampened with dr
solvent (fed. spec. P-D-680). Dry thoroughly.

(2) Inspect the fuel pump for cracks, damaged threads, damaged electr
connector, and other visible damage; replace a defective fuel pump.

d. Reassembly and Installation.

(1) Install plunger assembly (13), plunger spring (12), new cup gaske
ing cup (10), and screws (9).

(2) Install filter screen (8), new gasket (7), and cover (6).

(3) Insert the fuel pump in the heater case through the control panel
tall wire (4), screws (1), lock washers (3), and nuts (2). Connect cable

(4) Install the elbow, pipe nipple, and fuel filter. Connect the fue
e to the fuel filter. Connect the fuel tube to the fuel pump and fuel fl

(5) Install the control panel. Connect the fuel supply line and the
g. Check for proper operation. Check for leaks around the fuel pump fil
fuel lines. If any leakage is detected, shut off the heater, disconnect
g, and correct the leak. Retest heater operation and, when it is satisfa
tall the left side cover panel.

CHAPTER 11

REPAIR OF HEAT EXCHANGER, EXHAUST CONNECTION, AND RAIN SHIELD

11-1. DESCRIPTION.

a. Heat Exchanger. The heat exchanger is a bundle of stainless ste
a large surface area. It is open to the burner head at one end, and co
let for gases near the other end. The burning fuel and air mixture hea
of the heat exchanger. The blower motor blows circulating air around t
the heat exchanger, where the air picks up heat from the heat exchange
passes through the warm air louver into the enclosure to be heated.

b. Exhaust Connection. The exhaust connection is an insulated tub
which carries the gases from the heat exchanger to the exhaust pipe ou
closure to be heated. It is located in the bottom of the heater case
connected to the heat exchanger and the exhaust fitting.

c. Rain Shield. The rain shield is located on the back of the hea
is removable to allow connecting an air inlet tube which can draw air
enclosure to be heated.

11-2. REMOVAL AND DISASSEMBLY.

WARNING

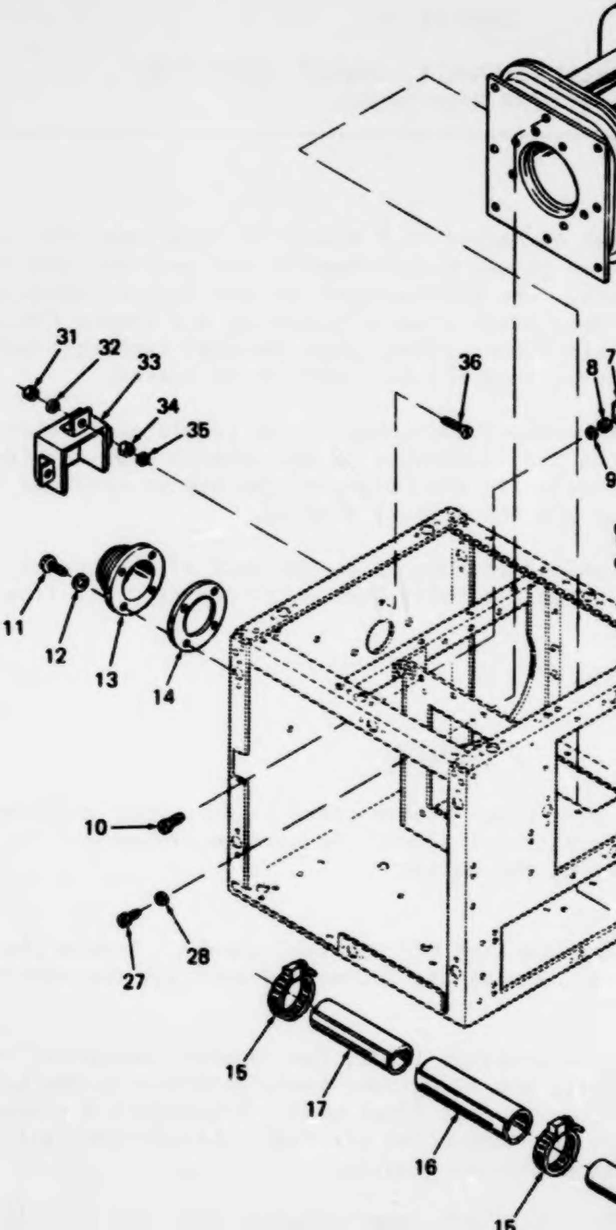
The ignition system of this space heater contains dangerous vol
which can cause severe electrical shock. Be sure to disconnect
power plug before repairing the heater.

a. Disconnect the power plug and shut off the fuel supply. Remove
nd heat exchanger cover panels. Remove the louver and pull out the c
he full extent of its wires.

b. Disconnect the glow plug thermostat leads, fuel heater thermost
eater leads, fuel solenoid leads, and all ground leads attached to th
onnect the fuel supply tube from the fuel float bowl. Disconnect the
ube at the compressor. Remove the combustion air tube. Remove the l
emove the burner from the heat exchanger housing.

c. Remove the bent clip (3, fig. 11-1), seal retainer (4), and sea

d. Remove four screws (11) and lock washers (12). Remove exhaust



Legend for fig. 11-1;

1. Nut
2. Lock washer
3. Bent clip
4. Seal retainer
5. Nut
6. Lock washer
7. Seal
8. Nut
9. Lock washer
10. Screw
11. Screw
12. Lock washer
13. Exhaust fitting
14. Exhaust insulation
15. Clamp
16. Exhaust pipe cover
17. Exhaust pipe insulation
18. Exhaust
19. Nut
20. Lock washer
21. Screw
22. Lock washer
23. Exchanger support
24. Clamp
25. Insulation
26. Exhaust seal
27. Screw
28. Lock washer
29. Pipe plug
30. Heat exchanger
31. Nut
32. Lock washer
33. Rain shield
34. Nut
35. Lock washer
36. Screw

f. Remove exchanger support (23), clamp (24), insulat
(26) by removing nut (19), lock washer (20), screw (21),

g. Remove three nuts (31), lock washers (32), and rem
is not necessary to remove nuts (34), lock washers (35),
the rain shield from the heater case.

h. Remove the heat exchanger from the heater case.

11-3. CLEANING AND INSPECTION.

WARNING

Clean parts in a well-ventilated area. Avoid inha
and prolonged exposure of skin to cleaning solvent
thoroughly. Dry cleaning solvent (fed. spec. P-D-
is potentially dangerous to personnel and property
flame or excessive heat. Flash point of solvent i

a. Clean all metal parts in dry cleaning solvetn (fed
wire brush to clean the heat exchanger. If necessary, us
the inside of the heat exchanger before reinstalling it i

WARNING

The heat exchanger confines the combustion gases a
exhaust pipe. It must be air tight to prevent ha
from entering the heater enclosure. Any crack or
walls requires exchanger replacement.

b. Inspect the heat exchanger and its exhaust tube f
excessive corrosion, and other damage. Replace a damage
tube.

c. Inspect seals and insulation for damage. Replace
insulation (14) may be reused if it is not distorted, co

11-4. REASSEMBLY AND INSTALLATION.

a. Install the heat exchanger, rain shield, exhaust
the reverse order of the index numbers in figure 11-1.

c. Install the control panel and the louver. Install the heat
panel, side cover panel, and top panel. Connect the fuel supply l
Test the heater for proper operation.

CHAPTER 12

REPAIR OF BLOWER ASSEMBLY

12-1. DESCRIPTION. The blower assembly consists of a blower wheel c
housing, blower motor support, 28-volt motor, and an axial fan. Th
located at the rear of the motor and provides air under slight pressu
only. Combustion air is ducted through the combustion air tube to th
amount of combustion air to the burner is controlled by the adjustabl
located on the blower housing. Ventilation air is circulated around
the heat exchanger by the axial fan. This heated air passes through
louver to heat the enclosure.

12-2. REMOVAL OF BLOWER ASSEMBLY.

WARNING

The ignition system of this space heater contains dangerous vo
which can cause severe electrical shock. Be sure to disconne
power plug before repairing the heater.

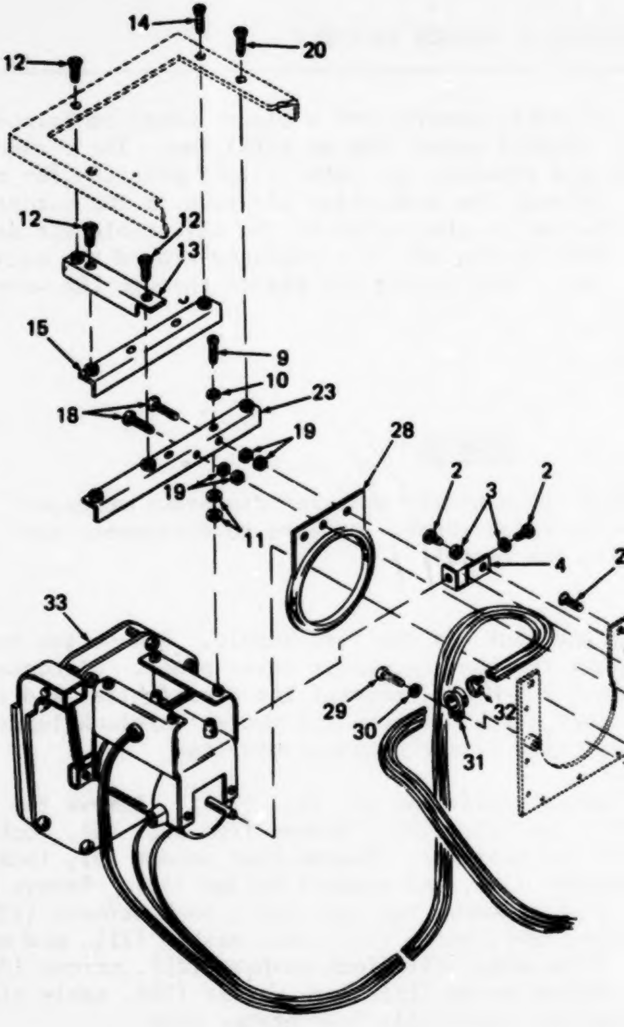
a. Disconnect the power plug and shut off the fuel supply. Remov
and both side cover panels. Remove the heat exchanger cover panel.
orange lead at the primary terminal block. Disconnect the green/whit
blue leads at the secondary terminal block. Disconnect two white/bla
burner. Remove the combustion air tube from the blower housing.

b. Loosen the setscrew and removal axial fan (1, fig. 12-1). Rem
(2), lock washers (3), and remove stabilizer (4). Remove five nuts
(6), and remove retainer seal (7) and seal (8). Remove four screws
(10), flat washers (11), three screws (12), and support bridge (13).
and remove back support bracket (15). Remove two nuts (16), lock wa
(18), four flat washers (19), screw (20), screw (21), lock washer (2
support stiffener (23). Remove three nuts (24), lock washers (25),
bar (27), and fan shroud (28). Remove screw (29), lock washer (30),
and cable tie (32). Remove blower and motor (33) from heater case.

12-3. DISASSEMBLY OF BLOWER MOTOR SUPPORT. Remove two screws, (1,
lock washers (2) from motor (24). Remove two nuts (3), lock washers
(5) from the motor studs. Separate motor and blower housing (25).
(6), lock washers (7), screws (8), and remove tube socket (13).

12-4. MOTOR.

a. Disassembly. If the suppression capacitor (14, fig. 12-3) or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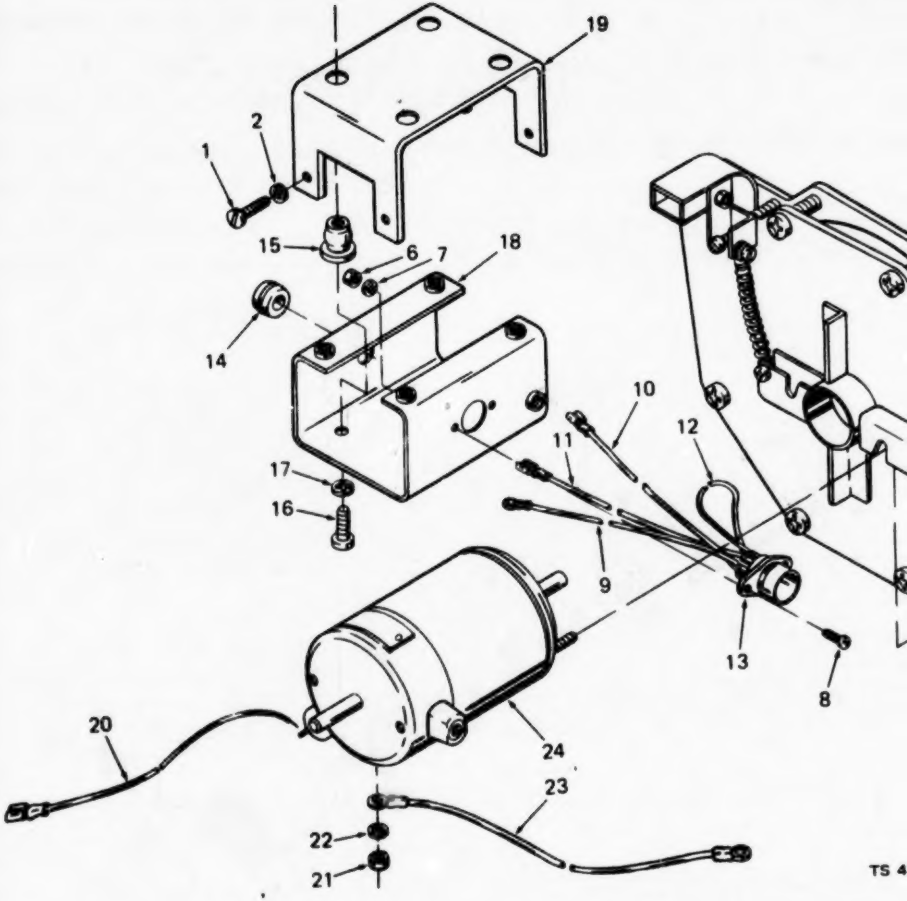
15
9
10
23
18
19
28
19
2
3
2
11
4
2
33
29
32
30
31

1. Axial fan
2. Screw
3. Lock washer
4. Stabilizer
5. Nut
6. Lock washer

12. Screw
13. Support bridge
14. Screw
15. Back support bracket
16. Nut
17. Lock washer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7
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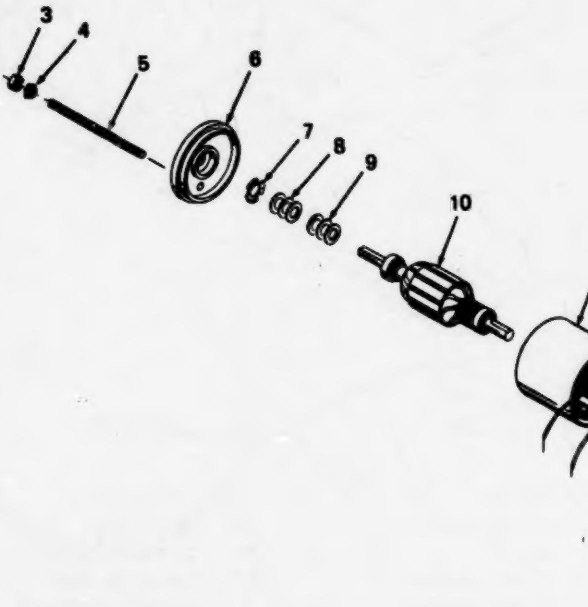
21
TS 4

1. Screw
2. Lock washer
3. Nut
4. Lock washer
5. Flat washer
6. Nut
7. Lock washer
8. Screw
9. Wire
10. Wire
11. Wire

14. Grommet
15. Well nut
16. Screw
17. Lock washer
18. Upper support
19. Lower support
20. Wire
21. Nut
22. Lock washer
23. Wire
24. Motor



1. Brush cap
2. Brush and spring
3. Nut
4. Lock washer
5. Stud

9. Washe
10. Armatu
11. Stato
12. Brush
13. Commu

(2) Remove nuts (3) and lock washers (4) that secure end bell (6) to t sembly; remove the end bell.

(3) Remove spring washer (7) and washers (8 and 9); retain washers for mbly. Pull armature (10) from stator (11).

(4) Separate the stator from commutator end bell (13) to provide acces e capacitor mounting hardware.

(5) Unsolder the electrical lead from the capacitor terminal inside th move nut (15) and lock washer (16), and remove capacitor (14) from the end b

b. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation of solvent fu and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean p is potentially dangerous to personnel and property. Do not use near o flame or excessive heat. Flash point of solvent is 100°F (38°C).

(1) Wipe the exterior of the motor assembly with a cloth dampened wit leaning solvent (fed. spec. P-D-680). Prevent solvent from entering the mot lean the motor stator and armature using clean, dry low pressure (30 psi max ompressed air to blow out dust and dirt. Wipe off any grease with a cloth d ith solvent.

(2) Clean metal parts in dry cleaning solvent and allow to dry thorou efore reassembly.

(3) Remove and inspect the motor brushes for cracks, chips, wear, or eplace brushes if damaged or if they are worn to less than 5/16 inch (8 mm).

(4) Inspect the condition of the motor commutator. Replace the motor ommutator is scored or badly burned. Light scoring of the commutator can be using fine sandpaper.

(5) Visually inspect the motor armature and stator for signs of overh r other damage. Inspect the bearings for wear and scoring. Replace defecti arts.

(6) Inspect the suppression capacitor for burned or broken insulation

c. Reassembly.

(1) Reassemble the motor in the reverse order of the index n
12-3.

(2) Use rosin-core solder when soldering the lead to the sup
(14).

12-5. BLOWER HOUSING.

a. Disassembly. If blower wheel (13, fig. 12-4) or air damper l
damaged, disassemble the blower housing as follows:

(1) Remove two nuts (1), lock washers (2), screws (3), and s

(2) Remove nine nuts (8), lock washers (9), and screws (10)
(18). Separate the intake housing (12) from the blower housing. Re
(13).

(3) Nut (14) is silver soldered to the linkage screw protrud
blower housing combustion air outlet. Do not disturb this assembly.

b. Cleaning and Inspection.

WARNING

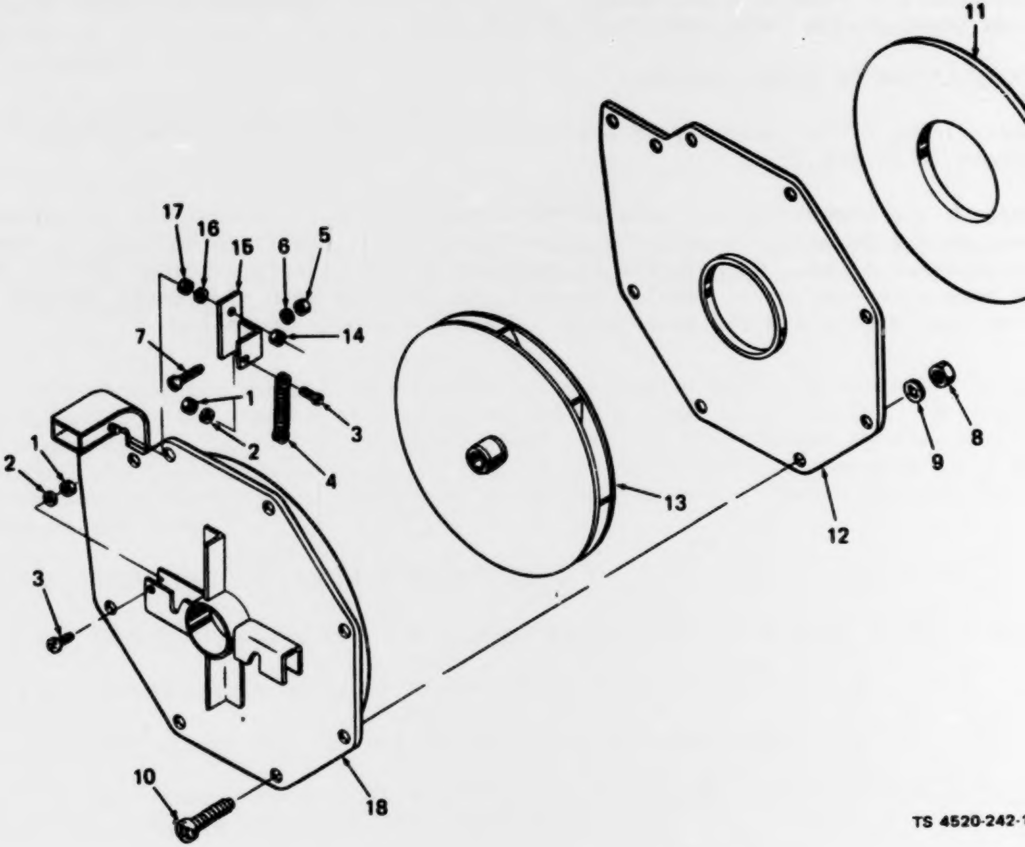
Clean parts in a well-ventilated area. Avoid inhalation of s
and prolonged exposure of skin to cleaning solvent. Wash exp
thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used t
is potentially dangerous to personnel and property. Do not u
flame or excessive heat. Flash point of solvent is 100°F (38

(1) Wipe the exterior of the blower housing with a cloth dam
cleaning solvent (fed. spec. P-D-680).

(2) Clean metal parts in dry cleaning solvent and allow to
before reassembly.

(3) Inspect the blower wheel for damaged or nicked vanes, lo
cracks. Replace a defective blower wheel.

(4) Inspect the air damper and linkage for restrictions or
bustion air outlet. The air damper and linkage should move freely
Slight damage can be corrected by bending the sheet metal of the com
Replace the blower housing if damage cannot be repaired.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5
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1
2
4
13
9
8
12
3
10
18

TS 4520-242-

1. Nut
2. Lock washer
3. Screw
4. Spring
5. Nut
6. Lock washer
7. Screw
8. Nut

10. Screw
11. Cushion
12. Intake housing
13. Blower wheel
14. Nut
15. Air damper linkage
16. Lock washer
17. Nut

(2) Seal the blower housing (18) and intake housing
732 RTV Silastic, or equivalent.

(3) Adjust nut (5) so when it rests against the back
(12) the air damper, in the blower housing, will have 5/16
from the side of the intake housing when the damper is in th

12-6. REASSEMBLY OF BLOWER MOTOR SUPPORT. Reassemble the b
the reverse order of the index numbers in figure 12-2.

12-7. INSTALLATION OF BLOWER ASSEMBLY.

a. Install the blower assembly in the heater case in the
index numbers in figure 12-1.

b. Install the combustion air tube on the blower housing
black leads to the burner. Connect the green/white, and red
secondary terminal block. Connect the orange lead to the pr
stall the heat exchanger cover panel. Install the top, and
Connect the fuel supply and the power plug. Check for prope

CHAPTER 13

REPAIR OF AIR COMPRESSOR

13-1. DESCRIPTION. The compressor assembly consists of a diaphragm type
pressor, mounting straps, and needle valve. The air compressor has an in
which moves the diaphragm. The adjustable needle valve controls the amou
going to the burner. The air, furnished by the compressor, atomizes the
the burner.

13-2. REMOVAL OF COMPRESSOR ASSEMBLY.

WARNING

> The ignition system of this space heater contains dangerous volta
> which can cause severe electrical shock. Be sure to disconnect th
> power plug before repairing the heater.

Disconnect the power plug and shut off the fuel supply. Disconnect th
and fuel supply. Remove the top panel and both side cover panels. Disc
orange lead at the primary terminal block, and the white/black lead at t
Remove the ignition power supply. Remove the air tube at the compressor
four screws securing the compressor to the heater case. Remove the comp
the heater case.

13-3. DISASSEMBLY OF COMPRESSOR ASSEMBLY.

a. Remove elbow (1, fig. 13-1), and needle valve (2 through 8) as an

b. If the needle valve is faulty, disassemble as follows:

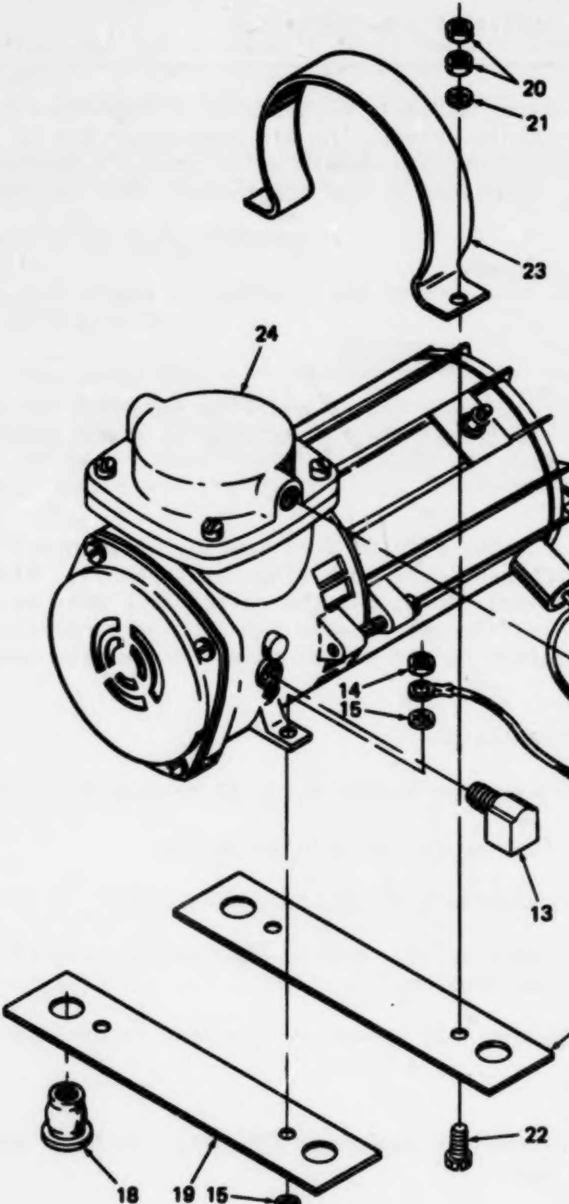
(1) Loosen nut (3) and unscrew knob (2) from needle (6).

(2) Remove washer (4), packing (5), needle (6), and housing (7)
assembly. Remove needle (6) from housing (7).

(3) Do not remove well nuts (18) unless replacement is necessary

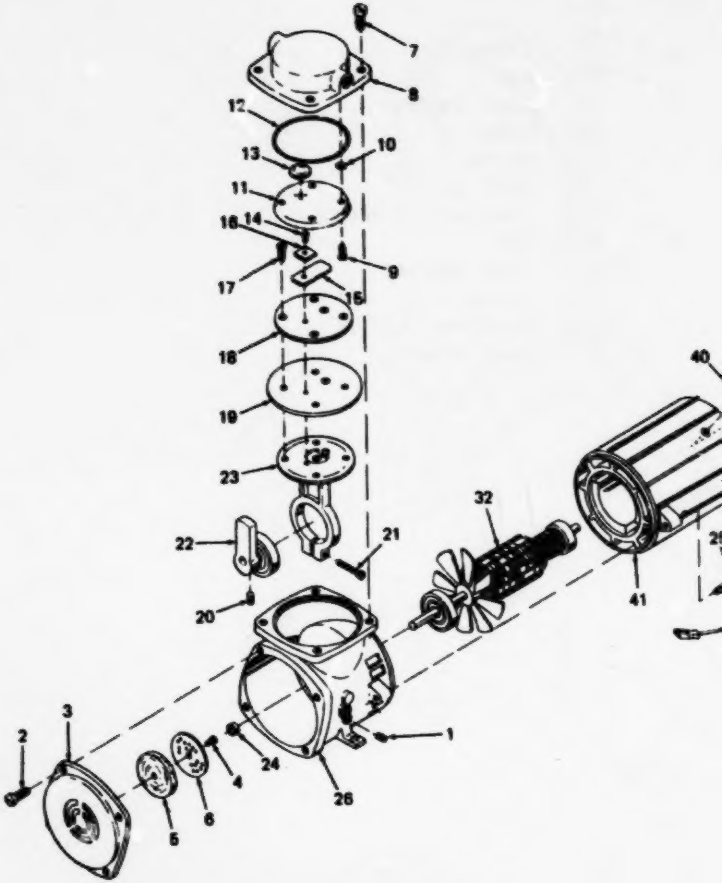
13-4. AIR COMPRESSOR.

a. Disassembly. If the suppression capacitor (36, fig. 31-2) or mot



Legend for fig. 13-1;

1. Elbow
2. Knob
3. Nut
4. Washer
5. Packing
6. Needle
7. Housing
8. Body
9. Connector
10. Elbow
11. Tee
12. Nipple
13. Elbow
14. Nut
15. Lock washer
16. Wire
17. Screw
18. Well nut
19. Compressor mount
20. Nut
21. Lock washer
22. Screw
23. Retainer strap
24. Compressor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32
22
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41
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1
2
3
24
4
26
5
6

1. Pipe plug
2. Screw
3. Front cover
4. Screw
5. Screen
6. Filter
7. Screw
8. Head
9. Screw
10. Packing
11. Exhaust valve plate

15. Flapper valve
16. Valve keeper
17. Screw
18. Intake valve plate
19. Diaphragm
20. Setscrew
21. Screw
22. Eccentric and bearin
23. Connecting rod
24. Spacer
25. Screw

(4) Remove screws (9), packing (10), exhaust valve plate
and umbrella valve (13) from head (8).

(5) Remove screw (14), flapper valve (15), and valve keep

(6) Remove four screws (17) and remove intake valve plate
(19).

(7) Do not remove eccentric and bearing (22) from connect
replacement is required.

(8) Separate housing (26) and housing (41) by removing tw

(9) Remove two screws (27) and remove end cap (28).

(10) Remove two screws (29), lock washers (30), unsolder t
capacitor (36), and remove brush and lead wire assembly (31). Re

(11) Unsolder lead wire (33), remove nut (34), lock washer
(36).

b. Cleaning and Inspection.

WARNING

Clean parts in a well-ventilated area. Avoid inhalation c
and prolonged exposure of skin to cleaning solvent. Wash
thoroughly. Dry cleaning solvent (fed. spec. P-D-680) use
is potentially dangerous to personnel and property. Do nc
flame or excessive heat. Flash point of solvent is 100°F

(1) Wipe the exterior of the compressor with a cloth damp
ing solvent (fed. spec. P-D-680). Prevent solvent from entering
motor. Clean the motor stator and armature using clean, dry, lo
maximum) compressed air to blow out dust and dirt. Wipe off any
dampened with solvent.

(2) Clean metal parts in dry cleaning solvent and allow
before reassembly.

(3) Remove and inspect the motor brushes for cracks, chi
Replace brushes if damaged or if they show excessive wear.

(4) Inspect the condition of the motor commutator. Repl
of the compressor if the commutator is scored or badly burned.

(6) Inspect the suppression capacitor for burned
damage. If a capacitance tester is available, test the c
be 0.47 microfarad. If a capacitance tester is not avail
continuity with an ohmmeter. Replace the suppression cap
cates that it is shorted, or if the capacitance tester in

(7) Inspect the diaphragm for tears and laceratio
damaged or has lost its elasticity, it must be replaced.

(8) Inspect the connecting rod for scoring, galli
a damaged connecting rod.

c. Reassembly. Reassemble the compressor in the reve
in figure 13-2. Use new packings (10 and 12) when reasse
to the head.

13-5. REASSEMBLY OF COMPRESSOR ASSEMBLY. Reassemble the
reverse order of the index numbers in figure 13-1.

13-6. INSTALLATION OF COMPRESSOR ASSEMBLY.

a. Position the compressor in the heater case and ins

b. Install the air tube at the compressor outlet. In
supply. Connect the orange lead to the primary terminal
lead to the burner. Install the top and both side panels
fuel supply. Connect the power plug and turn on the fuel
operation.

c. If the needle valve was disassembled it will requi
needle valve as follows:

(1) Loosen nut (3, fig. 13-1) until knob (2) can

(2) With the heater operating, turn the knob unti
Visually inspect the heat exchanger; if the secondary or
turn the needle valve knob counterclockwise 1/8 of a tur
ing is obtained and the red glow is eliminated.

APPENDIX A

REFERENCES

TM 38-750	(The Army Maintenance Manual
TM 5-4520-242-23P	Organizational, DS and GS Re Special Tools Lists

APPENDIX B

COMPONENTS OF END ITEMS LIST

Section I. INTRODUCTION

B-1. SCOPE. This appendix lists Basic Issue Items (BII) for the
inventory items required for safe and efficient operation.

B-2. GENERAL. The components of end item list are the following

a. Section II. Integral Components of the End Item. (Not ap

b. Section III. Basic Issue Items. These are minimum essent
to place the heater in operation, to operate it, and to perform em
Although shipped separately packed, they must accompany the heate
and whenever it is transferred between accountable officers. The
assist you with hard-to-identify items. This manual is your auth
replace BII based on Table(s) of Organization and Equipment (TOE)
of Organization and Equipment (MTOE) authorization of the end ite

B-3. EXPLANATION OF COLUMNS.

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the il
the item is shown (if applicable).

(2) Item Number. The number used to identify item called
tion.

b. National Stock Number (NSN). Indicates the national stock
the end item which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by t
controls the design and characteristics of the item by means of i
ings, specifications, standards and inspection requirements to ic
range of items.

d. Description. Indicates the federal item name and, if requ
description to identify the item.

e. Location. The physical location of each item listed is gi

g. Quantity Required (Qty Reqd). This column lists the quantit
required for a complete major item.

h. Quantity. This column is left blank for use during inventor
ceived column, list the quantity you actually receive on your major
columns are for use when you inventory the major item at a later da
shipment to another site.

Section II.

INTEGRAL COMPONENTS OF END ITEM

Not Applicable

Section III.

BASIC ISSUE ITEMS

(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY			
						RCV'D	DATE	DATE	DATE
		Thermostat, Room			1				
		Connector, Electrical, Power			1				
		Connector, Electrical, Room Thermostat			1				
		Technical Manual Operator, Organizational and Direct Support Maintenance Manual (TM5-4520-242-13)			1				

APPENDIX C

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

C-1. SCOPE. This appendix lists expendable supplies and materials you operate and maintain the heater. These items are authorized to you by CT Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Ite

C-2. EXPLANATION OF COLUMNS.

a. Column 1 - Item Number. This number is assigned to the entry in and is referenced in the narrative instructions to identify the material cleaning compound, Item 5, App. D").

b. Column 2 - Level. This column identifies the lowest level of mai requires the listed item.

(enter as applicable);

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column 3 - National Stock Number. This is the National stock num to the item; use it to request or requisition the item.

d. Column 4 - Description. indicates the Federal item name and, if description to identify the item. The last line for each item indicates number followed by the Federal Supply Code for Manufacturer (FSCM) in pa applicable.

e. Column 5 - Unit of Measure (U/M). Indicates the measure used in the actual maintenance function. This measure is expressed by a two-cha betical abbreviation (e.g., ca, in, pr). If the unit of measure differs of issue, requisition the lowest unit of issue that will satisfy your re

Section II.

EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTI
1	C	9130-00-160-1818	Gasoline, Combat, MIL-G- gallons required for 8
2	C	9140-00-286-5294	Fuel Oil, Regular, DF-2 quired for 8 hour opera
3	C	9140-00-286-5286	Fuel Oil, Winter, DF-1 (quired for 8 hour opera
4	C	9140-00-286-5283	Fuel Oil, Arctic, DF-A (quired for 8 hour opera
5	O	6850-00-264-9038	Dry-Cleaning Solvent, P- 5 gallon container (as
6	O	8040-00-828-7385	Sealing Compound, No. 73 Dow-Corning (71984)

APPENDIX D

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

D-1. GENERAL.

a. This section provides a general explanation of all maintenance and
tions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates ov
sibility for the performance of maintenance functions on the identified e
component. The implementation of the maintenance functions upon the end
ponent will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required fo
tenance function as referenced from Section II.

d. Section IV contains supplemental instructions on explanatory note
ticular maintenance function.

D-2. MAINTENANCE FUNCTIONS.

a. Inspect. To determine the serviceability of an item by comparing
mechanical and/or electrical characteristics with established standards
ination.

b. Test. To verify serviceability and detect incipient failure by m
mechanical or electrical characteristics of an item and comparing those
tics with prescribed standards.

c. Service. Operations required periodically to keep an item in pro
condition, i.e., to clean (decontaminate), to preserve, to drain, to pai
plenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into
position, or by setting the operating characteristics to specified param

e. Align. To adjust specified variable elements of an item to bring
or desired performance.

f. Calibrate. To determine and cause corrections to be made or to b
[illegible] test, measuring and diagnostic equipments used in precisi

h. Replace. The act of substituting a serviceable like ty
or module (component or assembly) for an unserviceable counter

i. Repair. The application of maintenance services (inspe
just, align, calibrate, or replace) or other maintenance actio
riveting, straightening, facing, remachining, or resurfacing)
ity to an item by correcting specific damage, fault, malfuncti
part, subassembly, module (component or assembly), and item, o

j. Overhaul, That maintenance effort (services/actions) ne
item to a completely serviceable/operational condition as pres
standards (i.e., DMWR) in appropriate technical publications.
the highest degree of maintenance performed by the Army. Over
return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary
unserviceable equipment to a like new condition in accordance
turing standards. Rebuild is the highest degree of materiel
Army equipment. The rebuild operation includes the act of re
age measurements (hours/miles, etc.) considered in classifying
ponents.

D-3. COLUMN ENTRIES USED IN THE MAC.

a. Column 1, Group Number. Column 1 lists group numbers,
to identify components, assemblies, subassemblies, and module
assembly.

b. Column 2, Component/Assembly. Column 2 contains the n
assemblies, subassemblies, and modules for which maintenance

c. Column 3, Maintenance Functions. Column 3 lists the f
on the item listed in column 2. (For detailed explanation of
paragraph B-2.)

d. Column 4, Maintenance Level. Column 4 specifies, by t
time figure in the appropriate subcolumn(s), the lowest level
ized to perform the function listed in column 3. This figure
time required to perform the maintenance function at the indi
nance. If the number or complexity of the tasks within the l
tion vary at different maintenance levels, appropriate work t
for each level. The number of man-hours specified by the wor
the average time required to restore an item (assembly, subas
end item, or system) to a serviceable condition under typical
tions. This time includes preparation time, troubleshooting
ance/quality control time in addition to the time required to
tasks identified for the maintenance functions authorized in
chart. The symbol designations for the various maintenance l

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those c sets (not individual tools) and special tools, test, and support equipment to perform the designated function.

f. Column 6, Remarks. This column shall contain a letter code in alpha order which shall be keyed to the remarks contained in Section IV.

D-4. COLUMN ENTRIES USED IN TOOL AND TEST EQUIPMENT REQUIREMENTS.

a. Column 1, Tool or Test Equipment Reference Code. The tool and test reference code correlates with a maintenance function on the identified end component.

b. Column 2, Maintenance Level. The lowest level of maintenance autho the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test

d. Column 4, National/NATO Stock Number. The National or NATO stock n tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

D-5. EXPLANATION OF COLUMNS IN SECTION IV.

a. Reference Code. The code scheme recorded in column 6, Section II.

b. Remarks. This column lists information pertinent to the maintenanc being performed as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATIO

(1)	(2)	(3)	(	
Group number	Component/Assembly	Maintenance function	Maintena	
			C	O
01	HEATER ASSEMBLY	Install		0.5
		Service	0.2	
		Replace		0.5
02	HOUSING PANELS AND LOUVERS			
0201	Cover Panels	Inspect		0.1
		Service		0.1
		Replace		0.1
		Repair		0.3
0202	Louver	Inspect		0.1
		Service		0.1
		Replace		0.1
		Repair		0.3
0203	Case	Inspect		0.1
		Service		0.1
		Replace		
0204	Data Plates	Inspect		0.1
		Replace		
	Instruction Identification Schematic Wiring			
03	ELECTRICAL			
0301	Control Panel Assembly	Inspect		0.1
		Test		
		Replace		
		Repair		
	Switch, On-Off	Test		0.5
		Replace		0.5
	Reset, Time Delay	Test		
		Replace		
	Receptacle, Power and Thermo	Inspect		0.5
		Replace		
	Fuses	Inspect		0.1
		Replace		0.1
0302	Ignition Power Supply Assembly	Test		
		Replace		

(1) Group number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level C	 O	 F	 H	 D
03	ELECTRICAL - Continued						
0303	Wiring and Terminal Blocks	Inspect			0.1		
		Test			0.3		
		Replace			1.0		
		Repair			1.0		
0304	Motor Control Resistor	Inspect			0.1		
		Test			0.2		
		Adjust			0.5		
		Replace			0.3		
0305	Room Thermostat	Service		0.1			
		Inspect		0.1			
		Adjust	0.1				
		Replace		0.3			
0306	Overheat Thermostat	Test			0.5		
		Replace			0.6		
0307	Safety Thermostat	Test			0.5		
		Replace			0.6		
0308	Cartridge and Thermostat Assembly	Test			0.5		
		Replace			1.5		
0309	Glow Plug Thermostat	Test			0.5		
		Replace			0.6		
0310	Delay Relay	Test			0.2		
		Replace			0.1		
04	BURNER ASSEMBLY						
0401	Burner Head	Inspect			0.5		
		Service			0.5		
		Adjust			0.2		
		Replace			1.5		
0402	Spark Plug	Inspect		0.2			
		Service		0.2			
		Replace		0.2			
0403	Glow Plug	Inspect		0.2			
		Service		0.2			
		Test		0.2			
		Replace		0.2			
0404	Fuel Adjustment Needle	Inspect		0.2			
		Adjust		0.2			
		Replace		0.2			

¹ SUBCOLUMNS ARE AS FOLLOWS: C - OPERATOR/CREW; O - OR

Section II. MAINTENANCE ALLOCATION CHAR

(1)	(2)	(3)	(	
Group number	Component/Assembly	Maintenance function	Maintena	
			C	O
05	FUEL SYSTEM			
0501	Fuel Tubing and Fittings	Inspect	0.1	
		Service		0.1
		Replace		0.3
0502	Fuel Float Bowl	Service		0.3
		Replace		
		Repair		
0503	Solenoid Valve	Service		0.3
		Test		
		Replace		
0504	Fuel Filter	Inspect		0.2
		Service		0.2
		Replace		0.2
0505	Fuel Pump	Service		0.3
		Test		0.3
		Replace		
		Repair		
06	HEAT EXCHANGER			
0601	Exhaust Connection	Inspect		
		Replace		
0602	Housing	Inspect		
		Replace		
0603	Heat Exchanger	Inspect		
		Replace		
0604	Rain Shield	Inspect		
		Replace		
07	BLOWER ASSEMBLY			
0701	Axial Fan	Service		
		Replace		
0702	Blower Support Assembly	Inspect		
		Replace		
0703	Motor	Inspect		
		Test		
		Replace		
		Repair		
	Capacitor, Suppression	Test		
		Replace		
	Brushes	Inspect		
		Replace		

(1) Group number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level C	O	F	H	D
07	BLOWER ASSEMBLY - Continued						
0704	Blower Housing	Inspect			0.1		
		Replace			1.4		
		Repair			1.0		
08	COMPRESSOR ASSEMBLY						
0801	Diaphragm	Inspect			0.2		
		Replace			0.7		
0802	Motor	Inspect			0.2		
		Test			0.3		
		Repair			1.2		
	Capacitor Suppression	Test			0.5		
		Replace			0.5		
	Brushes	Inspect			0.3		
		Replace			0.3		
	Armature	Inspect			0.5		
		Service			0.5		
		Test			0.5		

Section III. TOOL AND TEST EQUIPMENT

(1) Reference code	(2) Maintenance level	(3) Nomenclature
		No special tools and test equi required. Standard tools and equipment contained in followi tool kits are adequate to acco plish maintenance functions li in Section II; Tool Kit, Service, Refrigerati Unit (SC 5180-90-CL-N18) Soldering Gun Kit

Section IV. REMARKS

MAINTENANCE ALLOCATION CHART

Reference code	Remarks
	No supplemental instructions or explanatory remarks the maintenance functions listed Section II. All fu ciently defined in Section I. Active time listed fo functions are with the heater in an off-equipment po

INDEX

Subject

Paragraph, Figure, Table, Number

A

ustment and Checkout, Initial 4-3c
uscment, Fuel . . . . 4-3c, F 4-6, F 4-9, 4-23d, 4-24d
ustment Needle, Fuel 4-23d, 4-24
inistrative Storage 1-3
 Combustion Tube . . . . T 4-1, 4-24
 Compressor
 Description 13-1
 Disassembly 13-3, 13-4
 Exploded View . . . . F 13-1, F 13-2
 Installation 13-6
 Reassembly 13-5
 Removal 13-2
 Tabulated Data . . . . T 1-1
 Tube, Combustion 4-23a
 Tube Installation, Combustion . . . . F 4-11

B

se Plan . . . . F 4-2, 4-3A
sic Issue Items List B-1
wer and Motor . . . . F 5-5, F 12-2
wer Assembly
 Description 12-1
 Disassembly 12-3
 Exploded View . . . . F 12-2
 Housing . . . . 12-5, F 12-4
 Installation 12-7
 Motor 12-4
 Motor Support . . . . F 12-1, 12-3, 12-6
 Removal 12-2
wer Motor . . . . T 1-1, F 5-6, F 12-3
wer Motor Support . . . . F 5-4
rner
 Cleaning and Inspection 9-3

Subject

Burner Assembly . . . .
Burner, Preventive Maintenance . . . .

C

Cable, Ignition . . . .
Case and Panels, Cover . . . .
Case Assembly, Heater . . . .
Case Maintenance, Heater . . . .
Case, Preventive Maintenance . . . .
Checkout and Adjustment, Initial . . . .
Checks and Services, Preventive Maintenance . .
   Operator/Crew . . . .
   Organizational . . . .
Case Assembly, Heater . . . .
Combustion Air Tube
   Description . . . .
   Installation . . . .
Components
   Control Panel . . . .
   Electrical . . . .
   Electrical Control . . . .
   Mechanical . . . .
   Suppression . . . .
   Timer . . . .
Compressor, Air
   Description . . . .
   Disassembly . . . .
   Exploded View . . . .
   Installation . . . .
   Reassembly . . . .
   Removal . . . .
   Tabulated Data . . . .
Concealment, Use of Natural Surroundings for
Connection, Typical Exhaust . . . .
Connectors and Controls, Heater . . . .
Connectors, Power and Thermostat
   Installation . . . .
Control Panel

Subject — *Paragraph, Figure, Table, Number*

Control Relay, Terminal Blocks, and Resistor . . . . . . F 8-1
Control Relay Terminal Identification . . . . F 5-2, F 8-3
Controls and Connectors, Heater . . . . F 2-1, F 4-5
Controls and Indicators . . . . 2-2, T 2-1
Cover Panels and Case 4-16a, 4-17

D

Data, Tabulated . . . . 1-10, T 1-1
Delay Relay, Fuel Heater, and Thermostats . . . . F 8-2
Delay Thermostat . . . . T 1-1
Description and Data 1-8
Destruction of Army Materiel to Prevent Enemy Use . . . 1-5
Differences in Models 1-9
Dimensions . . . . T 1-1
Direct Support
  Maintenance Instructions 5-1
  Tabulated Data . . . . T 1-1
  Troubleshooting . . . . T 5-1, 5-5
Dismantling for Movement 4-4
Draining Fuel 4-4f

E

Electrical Components, Maintenance of . . . . T 4-1, 4-19, 5-6
Electrical Control Components
  Cleaning and Inspection 8-3
  Description 8-1
  Installation 8-4
  Removal 8-2
Electrical Schematic Diagram . . . . F 1-3, F 6-1
Electrical System Operation . . . . F 4-14, 4-22
Electrical Wiring Diagram F 1-4, F 6-2
End Items List, Components of B-1
Enemy Use, Destruction of Army Materiel to Prevent . . . 1-5
Equipment
  And Tools 5-1
  And Tools, Special 4-6, 5-2
  Fails to Operate 2-3d, 4-8d

Subject

Exhaust Connection
  Cleaning and Inspection . . . .
  Description . . . .
  Exploded View . . . .
  Reassembly and Installation . . . .
  Removal and Disassembly . . . .
  Typical . . . .
Exhaust Installation . . . .
Expendable Supplies and Materials List . . .
Extreme Cold, Operation in . . . .

F

Filter, Fuel . . . .

Filter, Fuel Pump . . . .
Filter Service, Fuel . . . .
Fire, Destruction by . . . .
Fittings, Fuel . . . .
Flame Safety Thermostat . . . .
Float Bowl, Fuel . . . .

Forms and Records, Maintenance . . . .
Forms, Failure to Operate . . . .
Fuel Adjustment . . . .

Fuel Adjustment Needle . . . .
Fuel, Draining . . . .
Fuel Filter . . . .

Fuel Filter Service . . . .
Fuel Fittings . . . .

Subject	Paragraph, Figure, Tabl Number
Fuel Pump	T 1-1, T 4- 4-25d, 4-29, 1 10-4, F 10-
Fuel Pump Filter	F 4-21
Fuel System	T 4-1, 4-25 F 4-20, 10-
Fuel Tubes	4-28
Fuel Tubing and Fittings	T 4-1
Functions, Controls and Indicators	T 2-1
Fuse	T 1-1
Fuse Holders and On-Off Switch	4-18

G

Glow Plug	T 1-1, T 4- 4-23c, 4-2
Gunfire, Destruction by	1-5d

H

Hardware	5-8
Heater Case Assembly	F 4-12, 5-
Heater Controls and Connectors	F 2-1, F 4
Heater Installation	4-3b
Heater Internal Components	F 4-8, F 4- F 4-18
Heat Exchanger	
Cleaning and Inspection	11-3
Description	11-1a
Exploded View	F 11-1
Reassembly and Installation	11-4
Removal and Disassembly	11-2
High Altitudes, Operation at	2-10
Housing, Blower	F 12-4, 12
Housing Panels and Louver, Preventive Maintenance	T 4-1
Humid or Rainy Conditions, Operation Under	2-11

I

Subject

Ignition Power Supply
  Case Top
  Cleaning and Inspection
  Description
  Exploded View
  Installation
  Removal
Indicators and Controls
Initial Checkout and Adjustment
Inspecting and Servicing the Equipment
Inspection and Services, Maintenance
Installation
  Combustion Air Tube
  Exhaust
  Heater
  Of Separately Packed Component
  Or Setting Up Instructions
Instruction Plate
Interference Suppression Components
  Primary
  Secondary
Internal Components, Heater

L

Lines, Fuel
Location
Louver and Housing Panels, Preventive Main

M

Maintenance
  Allocation Chart
  Checks and Services
  Forms and Records
  Instructions
  Of Burner Assembly
  Of Electrical Components
  Of Fuel System
  Of Heater Case

Subject — *Paragraph, Figure, Table, Number*

- Mechanical Destruction 1-5b
- Misuse, Destruction by 1-5a
- Models, Differences in 1-8
- Motor and Blower . . . . . F 5-5, F 12-2
- Motor, Blower . . . . . F 5-6, F 12-3, 12-4
- Motor Support, Blower . . . . . F 5-4, F 12-1, 12-3, 12-6
- Movement
  - Dismantling for 4-4
  - Reinstallation After 4-5
- Multifuel Space Heater . . . . . F 1-1, F 1-2, F 4-3

O

- On-Off Switch . . . . . T 1-1, 4-18, 4-19b, 4-21
- Operation
  - At High Altitudes 2-10
  - In Extreme Cold 2-9
  - Under Rainy or Humid Conditions 2-11
  - Under Unusual Conditions 2-9
  - Under Usual Conditions 2-5
- Operator/Crew
  - Maintenance Instructions 3-1
  - Preventive Maintenance Checks and Services . . . . . T 2-2
  - Tabulated Data . . . . . T 1-1
  - Troubleshooting . . . . . T 3-1, 3-2
- Organizational
  - Maintenance Instructions 4-1
  - Preventive Maintenance Checks and Services . . . . . T 4-1
  - Tabulated Data . . . . . T 1-1
  - Troubleshooting . . . . . T 4-2, 4-10
- Overheat 4-22g
- Overheat Thermostat . . . . . T 1-1

P

- Panel Assembly, Control 4-16b
- Panel, Control
  - Cleaning and Inspection 6-3

Subject

Plate, Instruction
Plates, Identification
Plug
  Glow
  Spark

Power Connector
Power Filter
Power Supply, Ignition
  Case Top
  Cleaning and Inspection
  Description
  Exploded View
  Installation
  Removal
Preheater, Fuel
Preparation for Use
Preventive Maintenance Checks and Services
  Operator/Crew
  Organizational
Primary Interference Suppression Components
Pump, Fuel

Q

Quality Assurance/Quality Control

R

Radio Interference Suppression
Rain Shield
  Cleaning and Inspection
  Description
  Exploded View
  Reassembly and Installation
  Removal and Disassembly
Rainy or Humid Conditions, Operation Under
Receptacles

Subject — *Paragraph, Figure, Table, Number*

Replacement of Primary Interference Suppression Components 4-13, 4-14b
Reporting Equipment Improvement Recommendations 1-6
Reset Thermostat . . . . T 1-1
Resistor, Control Relay, and Terminal Blocks . . . . . F 8-1
Room Thermostat . . . . T 1-1, F 2-2, F 4-4, 4-19a, 4-20, T 4-1, 4-22e
Run 4-22c

S

Schematic Diagram, Electrical . . . . F 1-3, F 6-1
Scope 1-1
Secondary Interference Suppression Components 4-14
Separately Packed Components, Installation of 4-2
Serviceability Criteria, Equipment 1-4
Services and Checks, Preventive Maintenance 4-8
Services and Inspection, Maintenance 1-3d
Servicing and Inspecting the Equipment 4-1
Servicing Standby Heater 2-4
Setting Up or Installation Instructions 4-3
Shutdown 4-22f
Site, Storage 1-3b
Solenoid Valve . . . . T 1-1, T 4-1, 4-25b, 4-27, F 10-1, 10-1d, 10-3
Space Heater, Multifuel . . . . F 1-1, F 1-2, F 4-3
Spark Plug . . . . T 1-1, T 4-1, 4-23b, 4-24
Special Tools and Equipment 4-6
Standby Heater, Servicing 2-4
Starting 2-6
Startup 4-22a
Storage
  Administrative 1-3
  Plan 1-3c
  Site 1-3b
Suppression
  Capacitors . . . . T 1-1

Subject

  - Components, Secondary Interference . .
  - Components, Testing of . . . .
  - General Methods Used to Attain Proper
  - Radio Interference . . . .
- Switch, On-Off . . . .

T

- Tabulated Data . . . .
- Terminal Blocks, Resistor, and Control Re
- Terminal Identification, Control Relay .
- Testing of Radio Interference Suppressio
- Thermostat
  - Connector . . . .
  - Delay Relay . . . .
  - Flame Safety . . . .
  - Fuel Heater . . . .
  - Maintenance . . . .
  - Overheat . . . .
  - Reset . . . .
  - Room . . . .
- Time Delay Assembly . . . .
- Timer Components . . . .
- Timer, Delay Relay . . . .
- Tools and Equipment . . . .
- Tools and Equipment, Special . . . . .
- Transition . . . .
- Troubleshooting
  - Direct Support . . . .
  - Operator/Crew . . . .
  - Organizational . . . .
  - Procedures . . . .
- Tube, Air Combustion . . . .
- Tubes, Fuel . . . .
- Tubing and Fittings, Fuel . . . . . .
- Typical Exhaust Connection . . . . . .

Subject | *Paragraph*
Figure, Tab
Number

V

Valve, Solenoid . . . . T 1-1, T 4
4-25b, 4-27, F
10-1d, 10

W

Wiring 5-9
Wiring Diagram, Electrical . . . . F 1-4, F

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PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.	
6	2-1 a			In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders.
81		4-3		Callout 16 on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.
125	line 20			I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gaskett but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN.

SAMPLE

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
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REVERSE OF DA FORM 2028-2 (TEST)

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = . 39 inch
1 decimenter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = . 15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = . 035 ounce
1 dekagram = 10 grams = . 35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = . 34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 38.82 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = . 155 sq. inch
1 sq. decimenter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = . 386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = . 06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	0square meters	.836	square meters	square feet	10.764
			square meters	square yards	1.196
square miles	square kilometers	2.590	square kilometers	square miles	.386
acres	square hectometers	.405	square hectometers	acres	2.471
cubic feet	cubic meters	.028	cubic meters	cubic feet	35.315
cubic yards	cubic meters	.765	cubic meters	cubic yards	1.308
fluid ounces	milliliters	29,573	milliliters	fluid ounces	.034
pints	liters	.473	liters	pints	2.113
quarts	liters	.946	liters	quarts	1.057
gallons	liters	3.785	liters	gallons	.264
ounces	grams	28.349	grams	ounces	.035
pounds	kilograms	.454	kilograms	pounds	2.205
short tons	metric tons	.907	metric tons	short tons	1.102
pound-feet	newton-meters	1.365			
pound-inches	newton-meters	.11375			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C